CHAPARRAL CONVERSION AND CULTURAL RESOURCES ON THE PRESCOTT NATIONAL FOREST:

AN EXPERIMENTAL STUDY OF THE IMPACTS OF SURFACE MECHANICAL TREATMENT BY MARDEN BRUSH-CRUSHER

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Introduction

Mechanical brush treatment using a Marden Brush-Crusher is commonly used for temporary chaparral control or conversion to grassland in the Southwestern Region, but little systematic observation or evaluation of the impacts of these operations to archeological sites has been made. Several studies of this type of impact have been done in recent years for similar Forest management practices, such as juniper chaining (DeBloois, Green, and Wylie, n.d.) and scarification (Gallagher, 1977), but these studies involve different environments and do not discuss the specific physical impacts of brush crushing. As well, these studies were confined to the observation of impacts on artifically constructed surface artifact scatters and did not deal with impacts to architectural features nor specifically with damage to subsurface materials. The purpose of this study, therefore, is to describe a procedure by which any type of mechanical impacts to both surface and subsurface features and artifacts can be identified and at the same time to identify and give a preliminary assessment of the specific impacts of brush crushing on actual cultural properties.

The area utilized for this study is a relatively small (approximately 60 acres) parcel of Prescott National Forest land, located on the Walnut Creek Ranger District, near the U. S. Forest Service, Camp Wood Administrative site. The area is shown in Figs. 1, 2, and 3. As it was known previously that this parcel contained cultural properties of a type desired for testing, it was decided by the USDA, Forest Service, Southwestern Regional Office that a test of impacts could profitably be performed here in conjunction with the scheduled crushing operation. This study is a report of that test, carried out by myself and Harlow Yaeger of the Prescott National Forest, in the spring and summer of 1978 (Wood and Yaeger, 1978).

The study area parcel is a dissected, hilly area within a local topographic basin in a pre-Cambrian granite and schist upland, formerly capped with basalt. Surficial deposits in this area are thin and rocky, though some drainages, notably the one through the Camp Wood Administrative site, contain deep, fine sediment. A large percentage of the local surface, especially on hills and ridgetops, is exposed and decomposing granite bedrock. Soil types noted for the study area (Wendt, et al., 1976) are limited to Barkerville series--thin, rocky, skeletal soils--in the upland portions, and Mirabal--thin, gravelly, sandy, high-slope loams--in the bottoms. Neither has a high potential for agriculture without

modification. However, the parcel contains several pockets of sediment similar to that at Camp Wood which appear potentially productive.

The study area is located between 5800 and 5900 feet elevation and drains into nearby Pine Creek, a seasonal drainage. This creek is also supplied by a small spring near the administrative site, one-half to three-quarters of a mile east of the study area.

Climate in the study area is semiarid, as it receives less than 20 inches of precipitation in an average year. This figure is obtained by extrapolation from the weather recording station at Walnut Creek, 8 miles to the north, below the Juniper Mountains (Green and Sellers, 1964). Maximum rainfall comes in the summer months of July and August with December, January, and February providing most of the remainder of the year's precipitation, often in the form of snow. Summer temperatures in the study area probably run from the low 50's to the high 80's (Fahrenhiet) in July and August. Winters are considerably colder, with temperatures ranging from the low 20's to the 50's (Fahrenheit) during the day, with occasional lows below 10 degrees Fahrenheit. Frost-free season is, therefore, relatively short, probably less than 130 days, from June to October.

Vegetation in the study area is a complex mosaic consisting primarily of turbinella oak-manzanita chaparral with a sparse overstory of alligator juniper and Emory oak with a few pinyon, broken by stringers of ponderosa pine in the basins and drainages. The chaparral understory, locally quite dense, also contains some mountain mahogany, Fendler ceanothus, datil yucca, silktassel, beargrass, prickly pear and mammilaria cactus, and occasional patches of ring muhly and grama grasses (Fig. 3).

The conversion project which took place in the study area involved repeated travel over much of this vegetation by a Marden Brush-Crusher (Figs. 4 and 5). As is evident in the photographs, the Marden Brush-Crusher is a nonmotorized trailer device consisting of two slightly offset rollers fitted with hardened alloy "paddlewheel" blades. It is generally pulled by a large bulldozer-type tractor. The twelve blades on each roller are of two different widths (approximately 16 and 20 centimeters), providing an uneven gait, and the offset between rollers, which prevents the crusher from turning sharply to the right, provides for additional churning of the surface and a variation in blade angles at contact. The combination of these features and a gross weight of 44,000 pounds results in a very efficient cutting and removal of chaparral-type plants. However, this device can operate only in relatively low-slope areas not covered with a continuous tree canopy, and where the ground surface

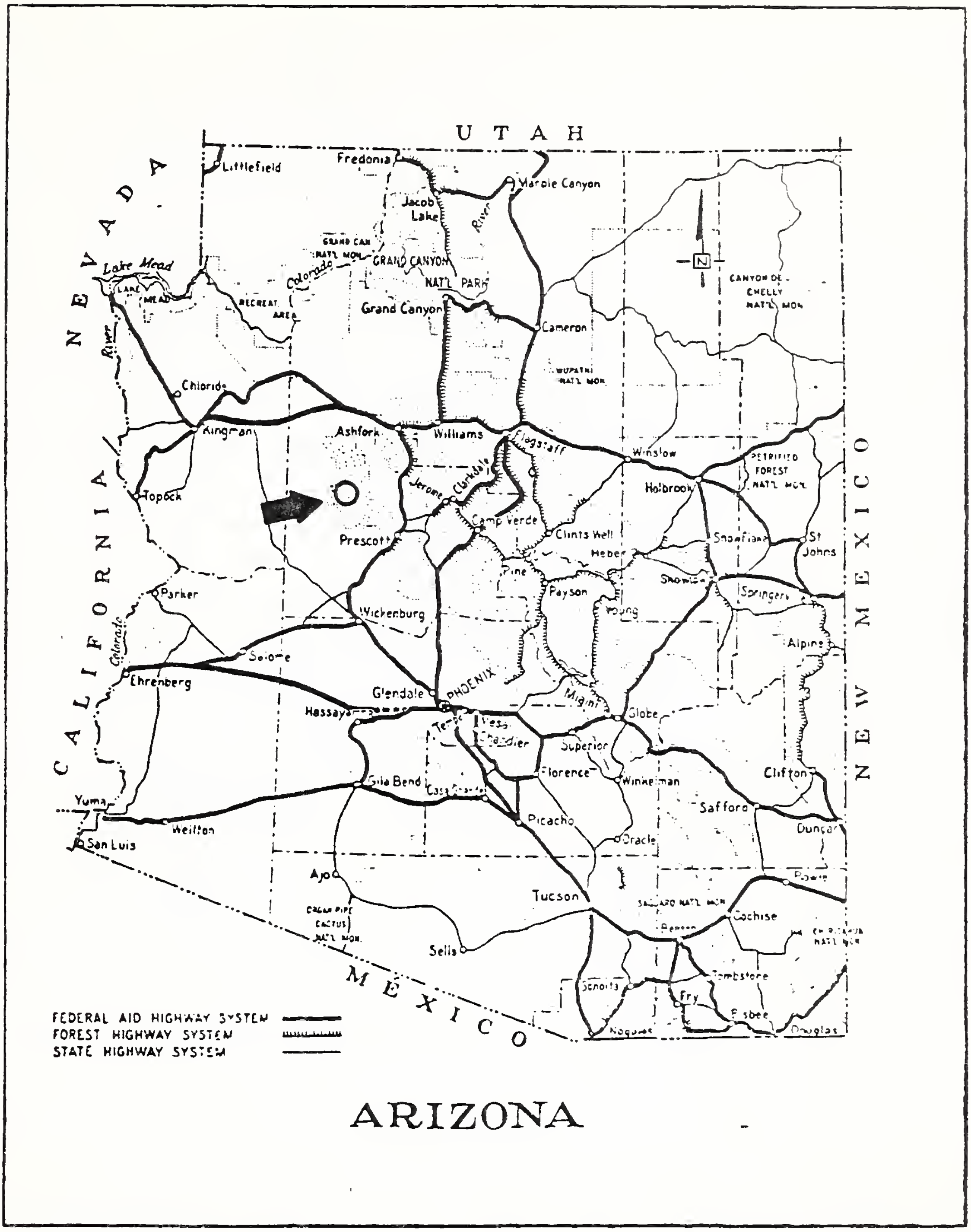


Fig. 1. Location of the Camp Wood Study Area

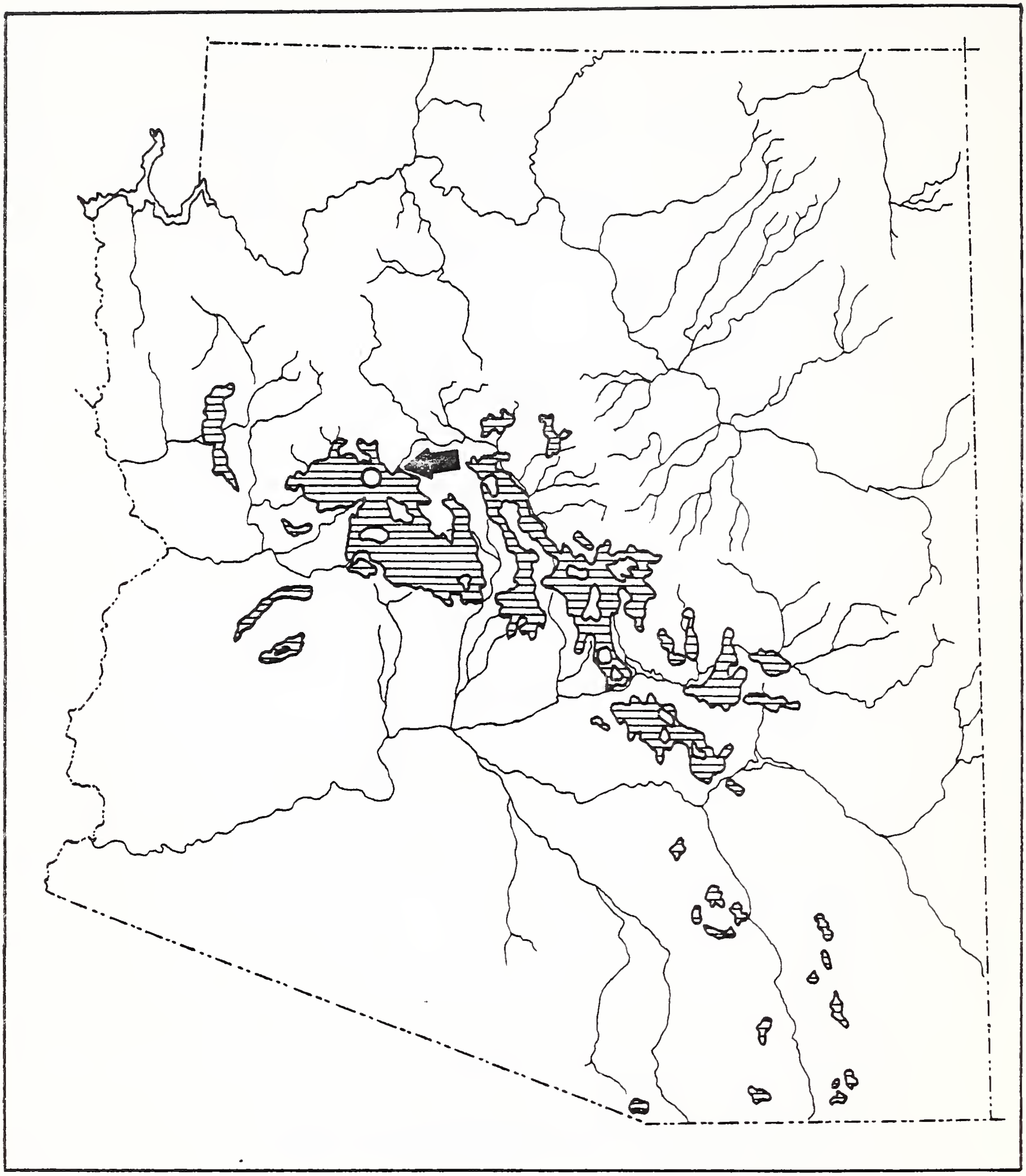


Fig. 2. Location of the Camp Wood Study Area in Relation to the Distribution of Chaparral Vegetation in Arizona

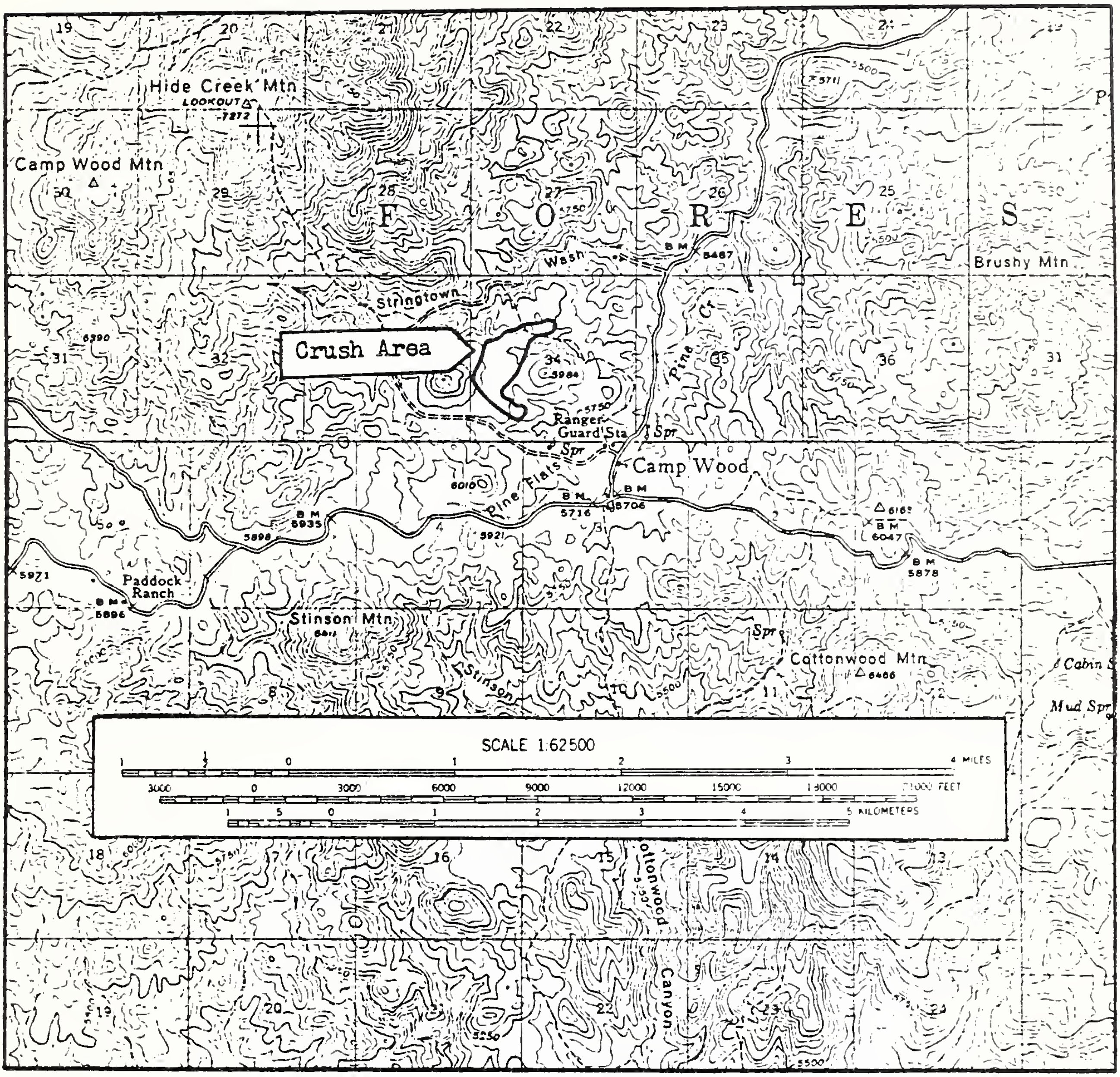


Fig. 3. Location and Topography of the Camp Wood Study Area

does not consist primarily of high relief exposed bedrock or talus. Rocky surfaces tend to dull and break the blades. Thus, its normal operation will leave a pattern of irregular patches of crushed and uncrushed stands of brush. The effectiveness of the treatment is evident in photographs of a nearby area (Figs. 6, 7, and 8) which was crushed in 1976. In the two years since this area was crushed, the only change that has occurred is the establishment of some grasses. The patterning of the cursh and the features of the surface disturbance remain obvious and the brush has made little in the way of a comeback.

Archeological Background

Introduction

In addition to the management orientation of this study, one of its major goals was to provide information on the nature and characteristics of the prehistoric cultural manifestation in this little known and poorly understood area (Wood and Yaeger, 1978). This information has been made available here as part of a continuing program of In-Service archeological investigation on the Prescott National Forest. The recording and presentation of such information is considered especially important in this case, owing to the loss of portions of potentially useful data during the tests. Therefore, as thorough a recording and interpretation as was possible, with the time and money available, was made of the descriptions, artifact inventories, environmental relationships, and intersite patterning of the study area properties and the cultural context in which they were found.

Survey and Inventory

Prior to the implementation of this study, the parcel selected was systematically and intensively surveyed in order to locate and identify the cultural properties it contained and to select from these a subject property for the study (Wood, 1978c). This survey took place on February 6 and April 6, 1978, and was conducted by myself; Harlow Yaeger, Prescott National Forest Liaison Officer and certified paraprofessional archeologist; Raven McReynolds, certified para-archeologist from the Verde Ranger District; and Jim Mackin, paraprofessional trainee from the Thumb Butte Ranger District. The survey located and described, or relocated and redescribed, a total of two sites and three nonsite surface artifact scatters within the parcel and an additional two sites outside the parcel boundary (Fig. 9). Those sites subject to impact but not selected for the study were flagged to mark them for avoidance. One site was selected for study and several loci within it were designated for specific aspects of the study. The locus chosen as a control was also flagged for avoidance. The test loci were not.

Fig. 4. Marden Brush-Crusher

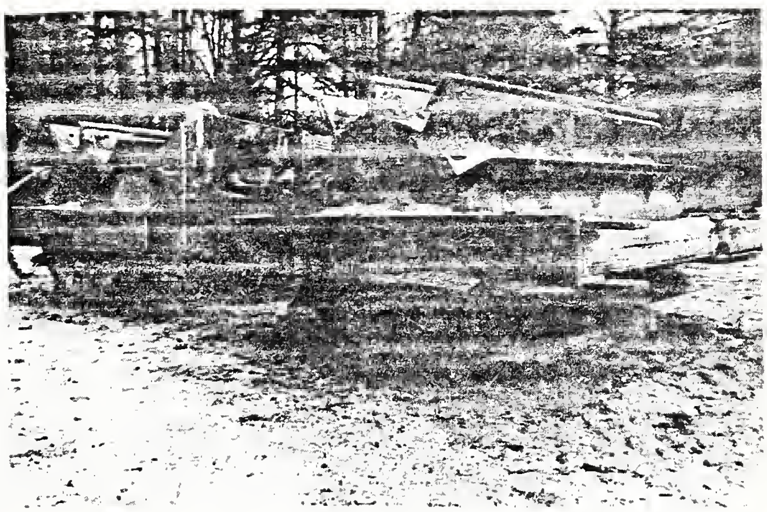


Fig. 5. Marden Brush-Crusher - Detail

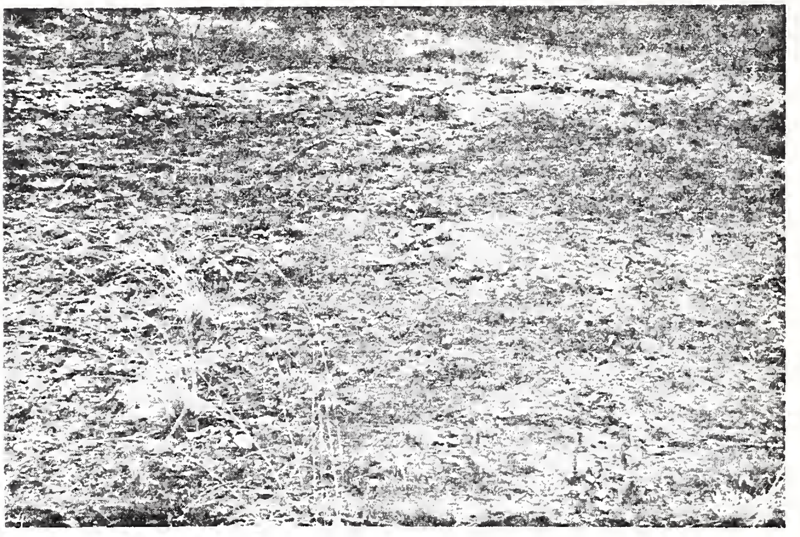


Fig. 6. Surficial Impact of Marden Device, 1976
(Photographed Feb. 1978)

Fig. 7. Surficial Impact of Marden Device, 1976
(Photographed Feb. 1978)

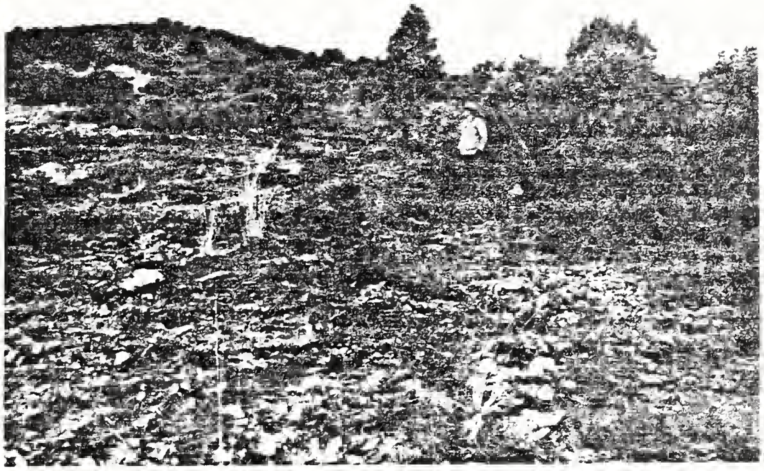


Fig. 8. Surficial Impact of Marden Device, 1976
(Photographed Feb. 1978)

Cultural Resouces in the Camp Wood Area

The types of cultural properties present in the parcel are typical of those in the Santa Maria and Juniper Mountains area. They consisted of boulder/rubble masonry "cellular" structures of two to six rooms (Figs. 10 and 11), small mounded masonry structures (Fig. 12), oval "rock ring" pithouses (see below), surface artifact scatters (Figs. 13 and 14), and hilltop masonry "forts" (Figs. 15, 16, and 17). Not found in or near the parcel was another habitation site type known from elsewhere in the surrounding area--multiroom masonry "pueblos" or "house mounds"--usually found in association with rock ring pithouses (Austin, 1978; Euler, 1976). Such sites are common in certain nearby localities (Austin, 1978), and are especially frequent along Walnut Creek, some 7 miles north of the study area.

Prior to this study, the only archeological investigations in the Camp Wood area have been cultural resource inventory surveys conducted by personnel of the Prescott National Forest and, on a part-time volunteer basis, by Ken Austin, an amateur archeologist from Prescott (Austin, 1978), who has provided his data to the Forest. In the early 1900's, Jesse Fewkes made a brief trip into nearby Walnut Creek, providing descriptions of several of the larger ruins, including one first reported by Whippe in the 1860's (Fewkes, 1912). Finally, there was a small survey and excavation by Robert Euler (1962) undertaken on the Yolo Ranch, west of Camp Wood. This work identified a similar assemblage of site types in the vicinity of Strotjost Flat, just outside the western Forest boundary.

Historic properties are also known from the immediate vicinity of the project area, but they have not received any systematic study to date. The Camp Wood Administrative site, one-half mile to the east, has a long history in the area. This location was originally the site of a small homestead and settlement, established ca. 1880. The current name may (or may not) be drived from a surveying expedition in the area, conducted in the 1870's or 1880's by a small cavalry unit under the comman of a Lt. Wood (Granger, 1960). However, this story is not given much credence locally, though several other topographic features in the area bear the name Wood. During the middle part of this century, the Camp Wood location supported a civilian conservation corps camp, a sawmill, and a small settlement, and a Forest Service Ranger Station, now maintained only as a work camp/administrative site. The area has also been long used for grazing and mineral exploration and a number of old ranches still

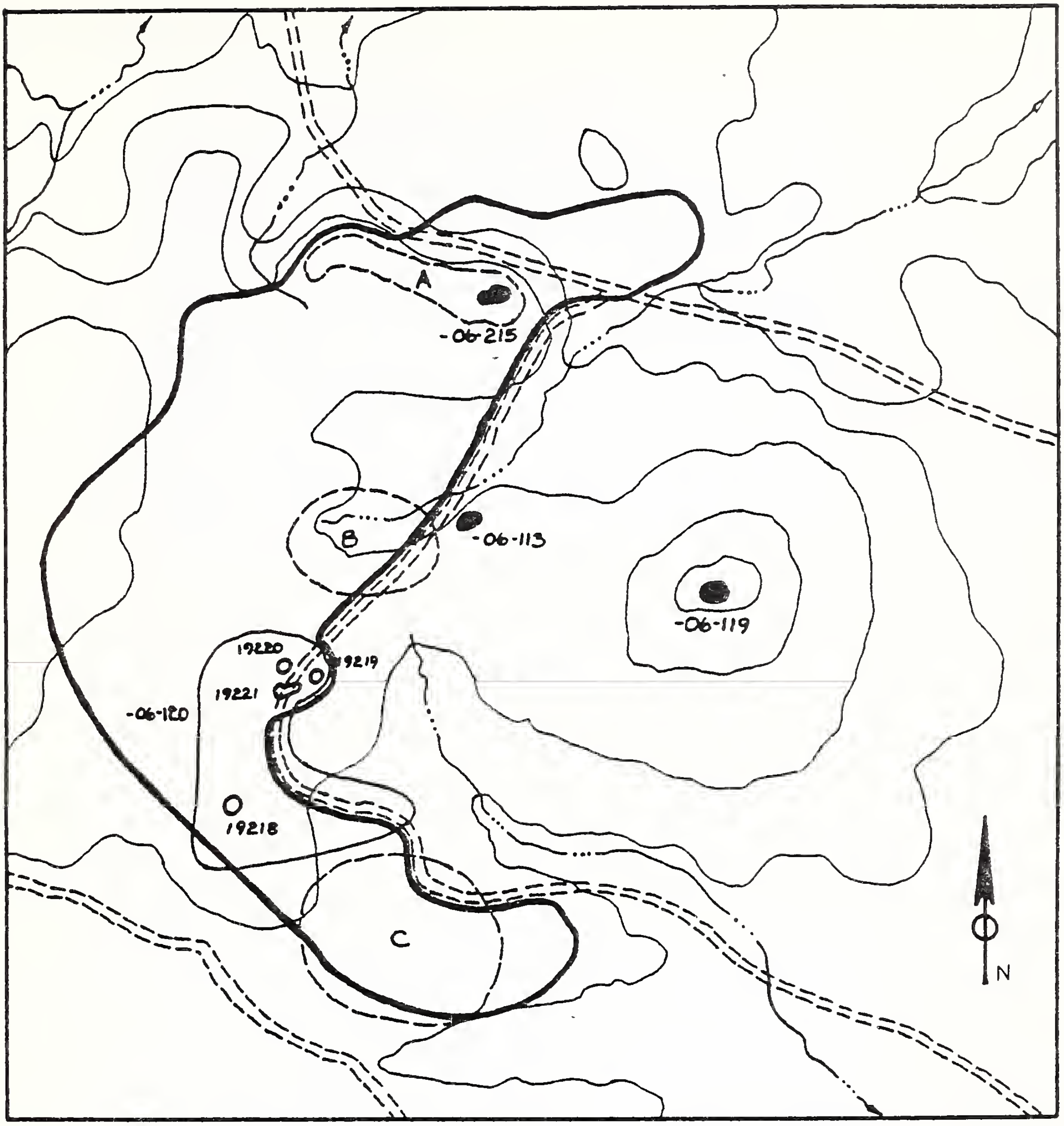
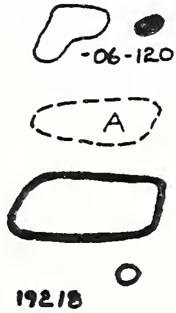


Fig. 9. The Camp Wood Study Area



archeological site

non-site artifact scatter

study area boundary

control/test locus

operate nearby, including one which operates an old Spanish land grant, the Luis Maria Baca Float No. 5. However, no historic properties were observed in the study area.

The site selected for this study was designated AR-03-09-06-120 and was originally recorded by Yaeger and Don Ward of Walnut Creek District. It consists of two architectural loci connected by a discontinuous are of occasional to heavy surface artifact scatter. The first locus arbitrarily designated 19218 for study identification purposes, contains a rock ring rectangular pithouse situated on a low ridge in mixed chaparral/oak-juniper-ponderosa woodland (see Figs. 18 and 25). The structure appears to have had fairly substantial rough masonry foundation walls and was large by local pithouse standards, measuring 4 meters by 7 meters. Ceramic types identified at this locus were predominately Prescott Plain and Aguarius Orange. Other types seen in much smaller quantities included Prescott Black-on-plain, Aquarius Black-on-orange, and a few sherds of Verde Red. Lithic materials, though not abundant, were predominately of local andesite and basalt and included a variety of flakes and hammerstones. Also observed were projectile points and flakes of obsidian and flakes of quartzite and chalcedony. In addition, a solid, hand-molded ceramic effigy foot (nonanthropomorphic) of Prescott Plain was found, along with several small nodules of obsidian ("Apache Tears"), and a small, unworked piece of turquoise. The other structural locus, 19219 (Figs. 19 and 39), contained a poorly defined partial rock outlined pithouse or other structure, approximately 2 meters by 5 meters in size. Surface artifactual remains at this locus were similar to those at 19218 with some exceptions: Verde Red quite rare here and no decorated ceramics at all were found, though another piece of turqoise was. Locus 19220 (Figs. 20, 51, and 52) was a small, concentrated scatter area near 19219. Artifactual remains here were similar to both 19218 and 19219. However, this locus had quite a high percentage of Verde Red and the scatter also contained a considerable amount of ground stone compared to the other loci. This included a more or less intact partial-trough metate of granite, a vesicular basalt mano fragment, and several basalt and andesite hammerstones. Locus 19221 (see below) is a noncultural area selected within the site near 19219 and 19220 for a particular phase of the testing.

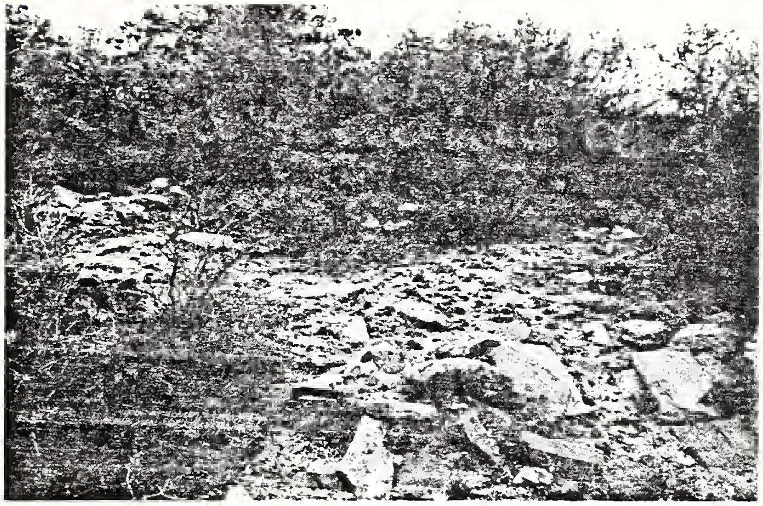


Fig. 10. Archeological Site From Study Area Showing Typical Architectural Features

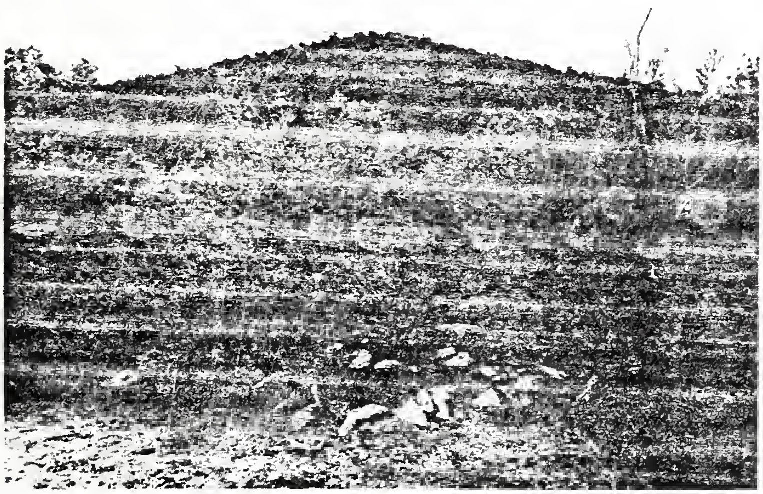


Fig. 11. Archeological Site From Study Area Showing Typical Architectural Features

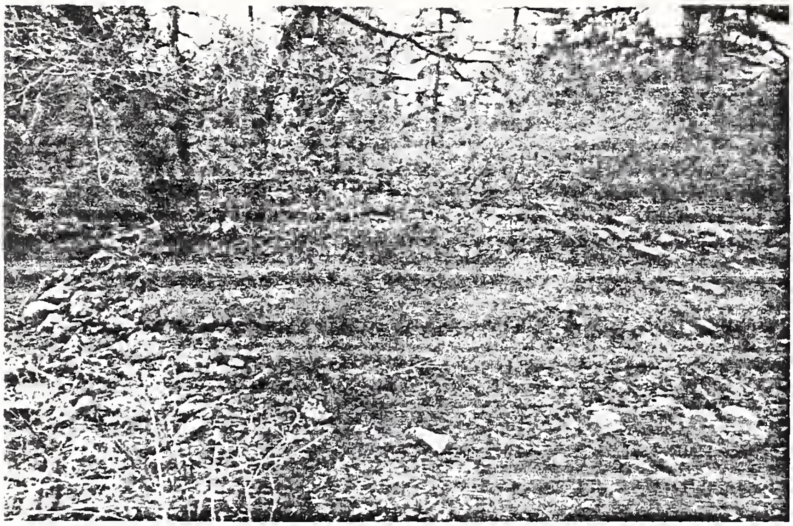


Fig. 12. Archeological Site From Study Area Showing Typical Architectural Features

Fig. 13. Surface Artifact Scatter From Study Area - High Density

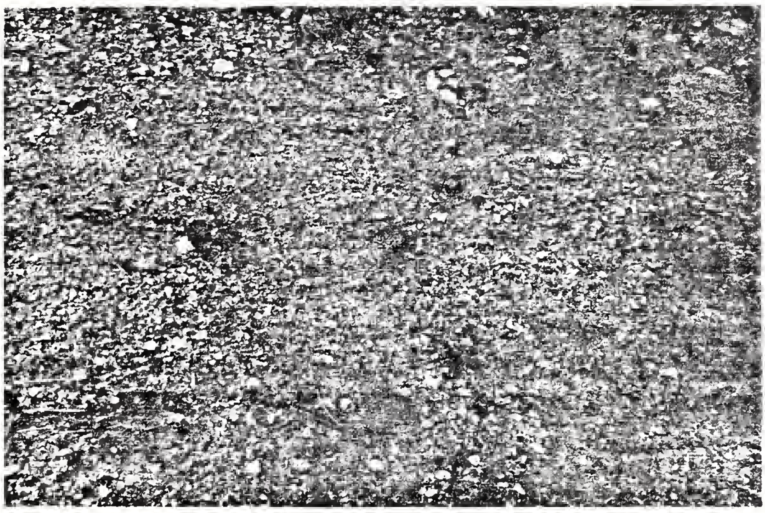


Fig. 14. Surface Artifact Scatter From Study Area - Low Density

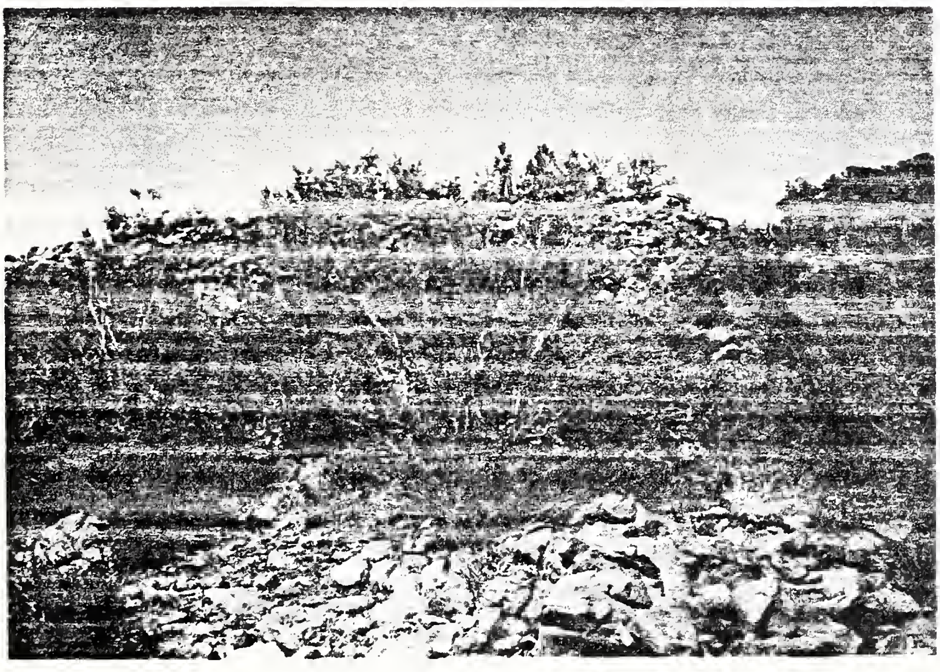


Fig. 15. Hilltop Fort East of Study Area - View North

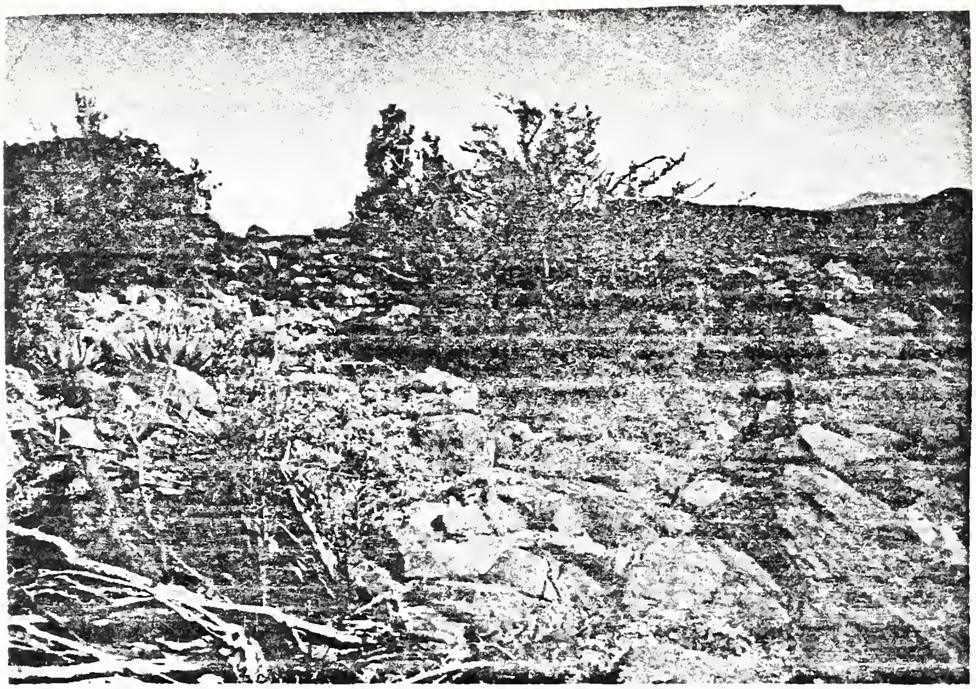


Fig. 16. Hilltop Fort East of Study Area - View East

Fig. 17. Hilltop Fort East of Study Area - View South

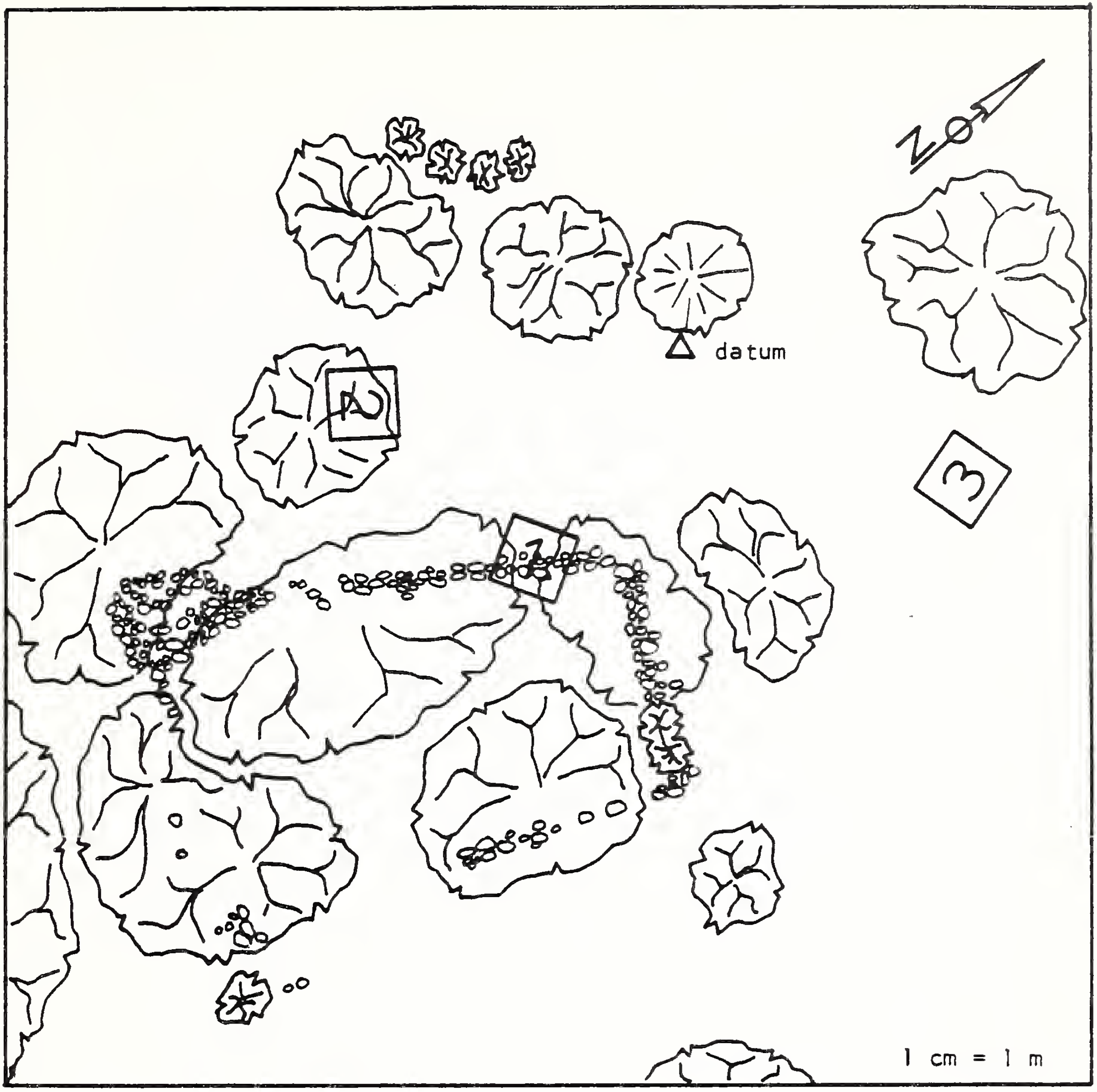


Fig. 18. Control Locus - 19218

test square locations shown by
numbered squares

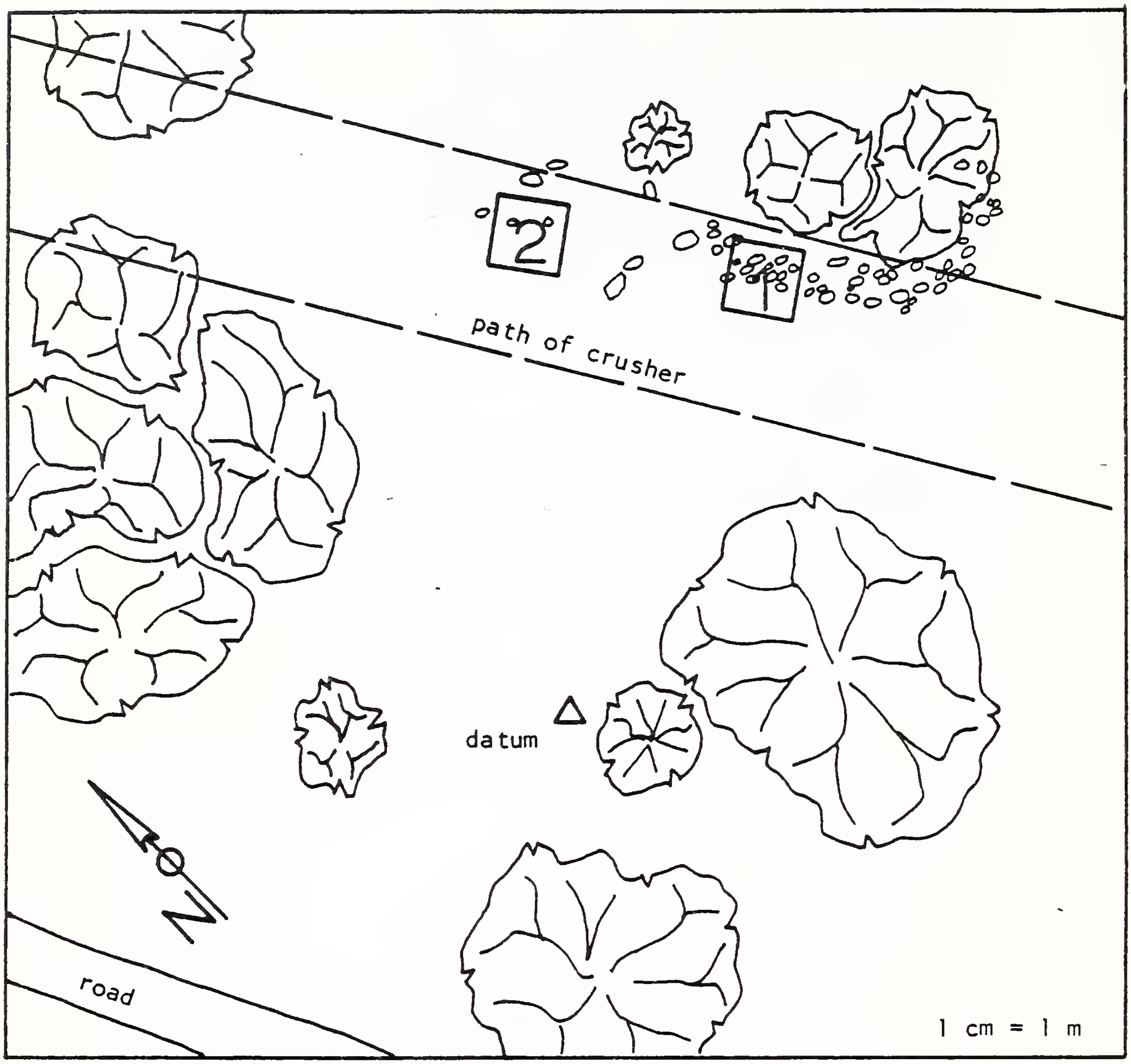


Fig. 19. Architectural Test Locus - 19219

test square locations shown by numbered squares

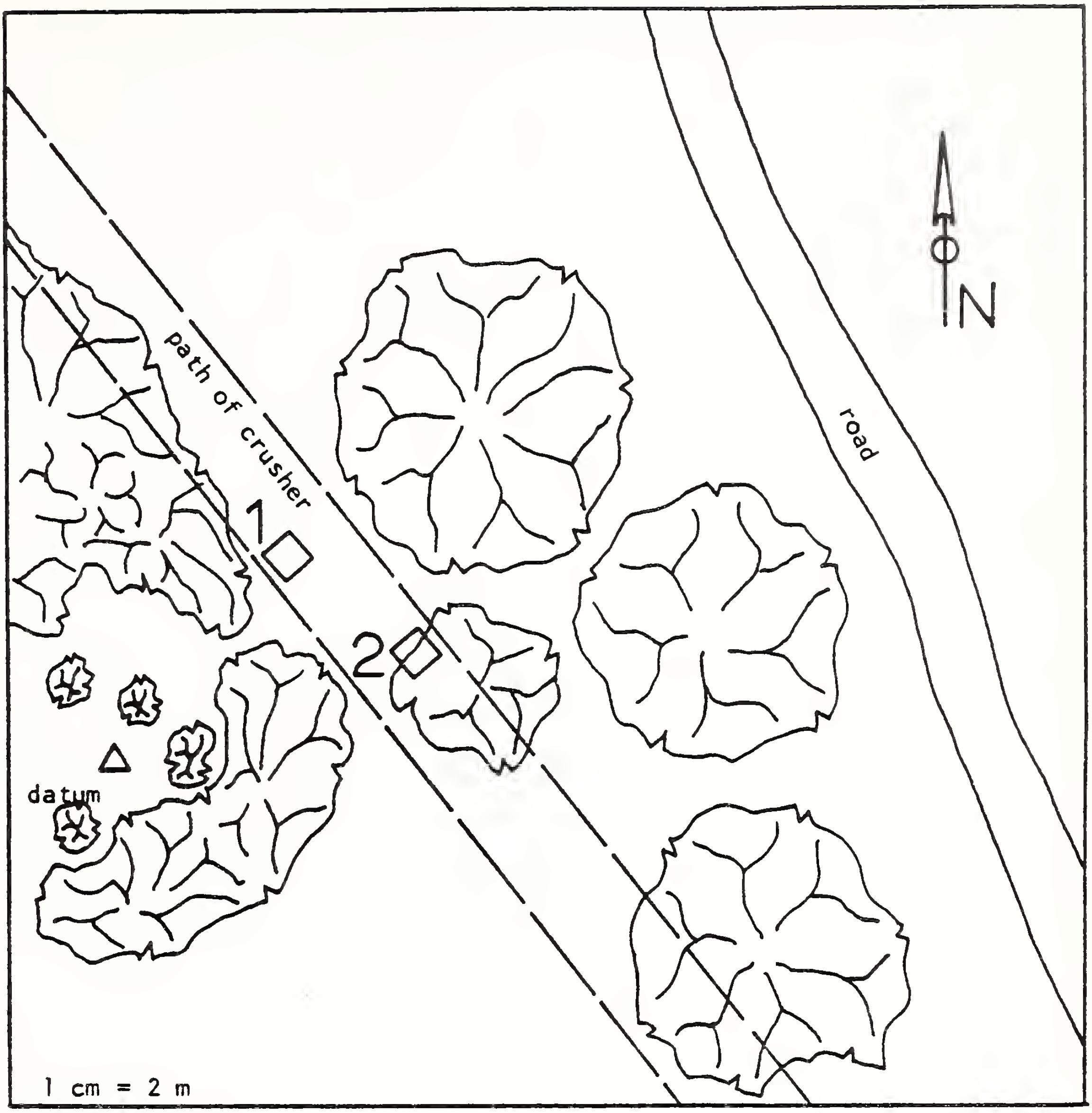


Fig. 20. Surface Scatter Test Locus - 19220

test square locations shown by
numbered squares

The cultural properties described above are typical of the archeological pattern found to the north and west of Prescott, Arizona. This pattern is designated the Prescott Branch. Formerly assigned to the poorly defined "Patayan" tradition (Colton, 1939), the pattern is better seen as a branch of the Hohokam tradition. The major material identifiers of the Prescott Branch assemblage are the ceramic types Prescott Plain, Prescott Black-on-plain, and Aquarius Orange, mentioned above. These types are characteristic of both the Prescott and Chino Phases of the Branch, and will be discussed in more detail below. The sites in the study parcel date to somewhere in the period 1000-1275 or 1300 A.D. They most likely derive from the period 1125-1300 A.D. (Chino Phase), based on the presence of intrusive ceramics found on and near the sites and on the assumed contemporaneity of a "fort" on the hilltop just to the east of and overlooking the study area, since such structures do not appear to have been introduced to the Prescott area until about 1100 A.D. (Jeter, 1977; Wood, 1978a).

The cultural properties in the study parcel appear to represent a relatively short-term occupation by a small population primarily dependent on land-intensive agriculture for some aspect of their socioeconomic system. This inference is derived from a high incidence of projectile points, a general scatter of artifactual materials throughout all areas containing economically useful plants (pinyon, juniper, oak, manzanita), and the relatively rare occurrence of nearby agricultural features such as checkdams, terraces, or other soil/runoff catchment and diversionary structures. Nevertheless, these sites are located only a short distance from the arable floodplain at Camp Wood, and other sites in the vicinity are closely associated with agricultural features, some of which are quite complex and extensive. That the role of agriculture in this system was important is probably best indicated by settlement patterning. Whatever the degree of dependence on agriculture for subsistence, it was important enough that most sites in this area are located in proximity to agriculturally useful and productive soils, such as Lynx Loam, which occur discontinuously in isolated alluvial pockets (Wendt, et al. 1976). This observation, though based on only a small sample of sites visited during the project, is compatible with patterns of site location elsewhere in the Prescott area as described in several previous analyses (Jeter, 1977; Wood, 1978a).

The dispersed settlement pattern and the general, nonconcentrated distribution of exotic "trade" goods such as turquoise and obsidian which were observed in the study area indicate a relatively low level of interfamily social organization (Plog, 1974; Wood 1978b; Wood and McAllister, in preparation). The presence of the "fort" argues for communal undertakings, but the lack of evident planning and the number and patterns of additions to that structure indicate that any such communal effort was periodic, temporary, and under transient leadership. Still, this

small localized population was part of and probably derived some type of support from the larger tradition of Hohokam, and through that tradition maintained contacts, represented by "trade" or nonlocal goods, with other populations in the surrounding region.

The settlement, economic, and organizational patterns seen here in the prehistoric population are virtually the same patterns, on a somewhat different scale, as those which characterize the historic and recent Anglo population of the area. This population was primarily dispersed in small family units (ranches) which practiced a mixed land-intensive (agriculture) and land-extensive (cattle) subsistence. These small settlements were also associated with agriculturally productive soils and are usually found in locations evidencing prehistoric occupation. Thus, the Anglo inhabitants were also a locally self-sufficient population with social and material ties to other populations maintained through a shared larger cultural and economic tradition. It would appear then, that similar patterns of land use and resource recognition have characterized several unrelated populations occupying the same area, hundreds of years apart. This being the case, information about the size, distribution, and economic success (duration of occupation) of the prehistoric population could have real bearing on modern patterns of land use in the area.

The Prescott Branch

The Prescott Branch of the Hohokam tradition has been poorly understood through most of the time since its recognition by Spicer (1936) in the early 1930's. It has been variously called "puebloid", Yuman, Patayan, Hakataya, and degenerate (Spicer, 1936; Caywood, 1936; Gladwin and Gladwin, 1930; Schroeder, 1960; Barnett, 1970, 1974). Only recently has it been even suggested that its origins might lie with the Hohokam tradition of south and central Arizona (Ward, 1975; Jeter, 1977; Weaver, Burton, and Laughlin, 1978; Wood, 1978a). This confusion has been due to certain professional and cultural biases on the part of investigators and to a general lack of knowledge of the regional variability in Hohokam. Now that more of this information is available (Breternitz, 1960; Weed and Ward, 1970; Weaver, Burton and Laughlin, 1978; Wood, 1978a; Wood and McAllister, in press; Wood and McAllister, in preparation), it becomes increasingly apparent that this archeological pattern is a branch of the Hohokam tradition, derived from the early colonization of the upper and middle Agua Fria River, the upper Hassayampa River, and the upper and middle Verde River drainages by Hohokam groups from the Salt River-Gila River-Lower Agua Fria River Basin (Fish, 1974; Weed and Ward, 1970; Weaver, Burton, and Laughlin, 1978; Breternitz; 1960).

Prior to the development of the Prescott Branch pattern, the area that it was later to occupy was inhabited or utilized by several archaic traditions, dating to the period 2000 B.C. to about 1-200 A.D. or later. These traditions were primarily Pinto Basin, first identified in southern California, and Cochise, which was, in various local forms, common to all of sub-Mogollon Arizona (McGregor, 1965). They are represented in the Prescott area by projectile point collections and occasionally recorded lithic scatters from the grassland and woodland areas around the upper Agua Fria River. Little, if anything, is known about this occupation, other than that its materials appear related to similar occupations in the Verde Valley, Lower Agua Fria-New River, and Salt-Gila Basin areas (Fish, Moberly, and Pilles, 1975; McGuire, 1977a; see additional discussion in Wood, 1978a). Even less is known about the period following the archaic manifestation, as no identifiable population has been recorded for the area. This may indicate a continuation of Cochise Archaic patterns here or that later occupations are masking earlier ones. It may even be that, for some reason, the area actually was uninhabited for several hundred years.

The Prescott Branch appears to have originated in the general vicinity of Prescott, in the uppermost reaches of the Agua Fria, Hassayampa, and Verde River drainages, sometime prior to A.D. 1000 (Jeter, 1977). This earliest or "formative" period, which may be roughly equated to the Colonial Period of the Hohokam tradition as it is now recognized, is only poorly understood. The description which follows constitutes a first attempt at defining it. This period/development, here given the tentative name "Kirkland Phase," probably dates to the period 700 or 800-1000 A.D. and appears to have been part of an upland expression of Colonial Hohokam patterns (cf., Jeter, 1977) which developed in the upper Hassayampa River Drainage. A number of characteristically Hohokam sites are known from this area which appear to date to the Colonial Period (Gladwin and Gladwin, 1930, 1935; Euler, 10th Ceramic Seminar, Museum of Northern Arizona, 1968). It is felt that these sites formed at least part of a nucleus around and from which at least the Kirkland Phase of the Prescott Branch developed. Another such nucleus may have been the Humboldt-Dewey portion of the Agua Fria Valley. This locality also contains a large Hohokam presence originating in the early Colonial Period (Weed and Ward, 1970), though its connections to the later Prescott Branch are not as strong as they are to later developments on the Lower and Middle Agua Fria (Wood, 1978a). A third possible nucleus may have been the Pioneer and Colonial Period Hohokam colony at Perkinsville, on the Upper Verde River (Fish, 1974). This assemblage, noted as having strong Prescott affinities prior to A.D. 1300, exhibits a phase development, dated 1000-1125 A.D., which incorporates non-masonry and partial masonry pithouse rancherias and Prescott Black-on-plain ceramics, and introduces the Tusayan Black-on-red/Black-Mesa Black-on-white complex of Kayenta Anasazi "trade" ceramics commonly encountered in northern Prescott Branch sites. This phase corresponds well with the Prescott Phase and follows an earlier phase exhibiting a strongly Hohokam occupation. However, the lack of any peripheral data

for the Perkinsville locality, the poor description available for its early phases and the strong ties to other traditions found in the Humboldt-Dewey area serve to confine the Kirkland Phase to the southern part of the Prescott Branch area, at least for now. Recent observation of Santa Cruz and Sacaton Phase Hohokam material in the Juniper and Santa Maria Mountains during this project may eventually change this.

Though little substantive data is available at the present time, the Kirkland Phase can be partially described from patterns observed in Copper Basin (Jeter, 1977) as having involved periodic ("seasonal" being a probable misnomer, implying too rigid and nonresponsive a system) or homestead use and occupation dispersed around the few Colonial Hohokam settlements in the upland valleys of the Hassayampa drainage. It would appear on this basis to be transitional between a Hohokam manifestation such as had developed in the Salt-Gila Rivers Basin and the highly localized later development of the Prescott Branch. One possible material aspect of this transition is a plainware ceramic ("Kirkland Grey"), which appears to be related both to Prescott Plain and to early varieties of Gila Plain. Though Colton (1939) originally assigned this type to the San Francisco Mountain Greyware, it appears on the basis of its published description to be much more strongly related to Prescott Plain. Further, it is described by Colton as underlying Prescott Plain stratigraphically and found in the early levels of at least one excavated Prescott Branch site. This type, here renamed "Kirkland Plain", would thus appear to be transitional between the Gila Plain of the Hohokam colonies and the Prescott Plain of the Prescott Branch, though a systematic study of this postulated development remains to be done. Even assuming that this postulated transition is supported, the apparent rarity of the type and the already strong similarity between Gila Plain and Prescott Plain precludes the use of this type as an identifier for any specific phase. As a final note, some degree of organizational hierarchy is suggested for this phase, since at least one of the central Hohokam colonies in the Kirkland area is reported to have contained a ball court and a relatively large population.

The two better known phases of the Prescott Branch development are the Prescott Phase, 1000-1125 A.D., and the Chino Phase, 1125-1275 or 1300 A.D. These dates are not the traditional ones, which terminate much earlier (e.g. McGregor, 1965), but reflect recent reassessments of ceramic (e.g. Breternitz, 1966) and tree-ring dates (Bannister, Gell, and Hannah, 1966) from those sites traditionally used to date the branch. These dates also represent more accurately the material, architectural, and settlement correlations between developments in the Prescott Branch and those in the Middle Verde Valley and Agua Fria drainages (Barnett, 1974; Breternitz, 1960; Schroeder, 1960; Weaver, 1974; Wood, 1978a).

The Prescott Phase appears to be a rough equivalent of the Sacaton Phase

in the Agua Fria drainage, as indicated by the finding of Sacaton Red-on-buff in Prescott Phase sites (Jeter, 1977; Ward, 1975), by the dates of Northern intrusive ceramics, and by a consistent presence of Prescott Black-on-plain in Sacaton Phase sites in the Lower Agua Fria (Arizona State University Archeological Site Inventory). It is represented by the same type of rock ring pithouse rancherias and homesteads characteristic of the Lower Agua Fria-Cave Creek Area (Rodgers, 1974; 1978). However, there is some indication that intra- and inter-community socioeconomic organization was on a somewhat lower level than in the desert riverine and upland populations, since there does not appear to have been a "central village" pattern, as was postulated for the Kirkland Phase and which was common on the Agua Fria. Also, the village-fort complex does not appear to have arrived in the Prescott Branch until very late in this phase (Jeter, 1977).

Overall, the Prescott Phase has the appearance of a period of population dispersal. Nevertheless, it represents an increasing occupation and use of the interior mountain woodlands and valleys and the open grasslands of Chino and Williamson Valleys. If the suspected Kirkland Phase is limited to the Upper Hassayampa drainage, it also represents a major expansion of the branch to the north.

The Chino Phase saw the adoption of certain developments both from Classic Period Hohokam populations in the Salt-Gila Basin and from the later patterns in the Middle Verde Valley. These included both rock-filled adobe and masonry walled multiroom "pueblo" structures (Spicer, 1936; Barnett, 1970; Euler, 1962; Austin, 1978) which served either as separate habitation sites or, quite commonly, as central features within fairly extensive rancherias (Euler, 1962; Austin, 1978; H. Yaeger and J. Mackin, personal communication). Hilltop forts also become common at this time, establishing a potential communication network reaching from the Juniper Mountains to the Salt River Valley (Austin, 1978; Gumerman, Weed, and Hanson, 1976).

The Prescott Branch occupation reached its greatest extent in the Chino Phase, occupying all the major alluvial areas of Chino, Williamson, Peoples, and Walnut Creek Valleys and extending up many of the major and minor drainages of the surrounding mountains. It is found from Yarnell to Seligman and from Big Chino to Big Sandy. It may even be that the maximum northern expansion which came at this time displaced the Cohonina tradition populations found in the northern portion of this range, as no Cohonina sites dating to after A.D. 1150 have been identified from this area. On the other hand, few if any post-1150 A.D. Cohonina sites are known from any locality (McGregor, 1951).

The ceramic assemblage of the Prescott Branch throughout its development was dominated by plainwares. As mentioned above, they are also the single most characteristic aspect of the branch's material culture. The primary type was Prescott Plain, a coarse-textured, paddle-and-anvil manufactured residual clay plainware, formerly known as Prescott or Verde Grey, though it is as commonly brown as it is a mottled grey. As discussed above, it was a probable variety of Gila Plain, usually unslipped and rough surfaced, though occasionally it was scraped smooth or scum-finished (hand smoothing with a liberal application of water). It was accompanied by a second plainware type, Aquarius Orange, which may be nothing more than a variety of Prescott Plain. This type was also unslipped as a rule, and had a light to dark reddish-orange surface, usually scum-finished. Vessel interiors were sometimes smudged to a dark or light grey, much more commonly than was Prescott Plain, and its appearance is often that of an imitation of contemporary Wingfield and Verde Redwares. The characteristic decorated pottery of the Branch was Prescott Black-on-plain, as noted above. This was a painted variety of Prescott Plain. It was simply decorated, often in rough imitation of Sacaton Red-on-buff or Sosi/Flagstaff Black-on-white styles, using a thin, watery carbon paint. It may have been preceded by a little-known type from the Perkinsville area called "Verde Red-on-grey (Fish and Whiffen, 1967), which was essentially similar to Prescott Black-on-plain but for having more strongly Hohokam designs similar to those of the Colonial and early Sedentary Period, done in a "blood red" mineral paint on a tan to grey unpolished surface.

The regional settlement pattern of the Prescott Branch appears on the basis of preliminary analysis of some rather extensive survey and excavation data (Prescott National Forest Archeological Site Inventory; Austin, 1978; Euler, 1962; Spicer, 1936; McGuire, 1977; Barnett, 1970; H. Yaeger and J. Mackin, personal communication; personal observation), to represent a more or less complex system of multiple patterns, especially in the Chino Phase, the best known and most densely populated period in the development of the branch. By this time, large, centralized, and permanent settlements were maintained on the hilltops and terraces along the major streamcourses while the upland mountain valleys bordering these drainages supported numerous small, amorphous sites, extensive agricultural systems, small habitation clusters with "forts", and isolated small habitation sites or homesteads. This settlement pattern apparently originated towards the end of the Prescott Phase and represents, on a lower level, the same type of differentiated and hierarchically integrated settlement system that characterized Hohokam development in the Salt-Gila Basin (Wood and McAllister, in press). Site locations appear to have been primarily determined by the availability of arable

soils, particular grades suitable for runoff manipulation, and dependable water, indicating an agriculturally based economy similar to that found in other upland Hohokam areas (Canouts, 1975; Rodgers, 1974; 1978; Wood, 1978a; Wood and McAllister, in preparation). However, the common occurrence of small scatters and amorphous temporary occupation sites in areas poorly suited to agriculture (e.g. McGuire, 1977) indicates as well a strong reliance on foraging.

Prescott Branch contacts with other traditions were also complex, but are poorly known. In the south, they appear strongest with the Salt-Gila Basin and Middle Verde Valley (Jeter, 1977; Ward, 1975), but an often confusing variety of contacts is evident at many sites throughout the branch, especially in the north. In the area north and west of Camp Wood, there are a large number of typical Prescott Branch sites which contain Prescott, Cerbat, Cohonina, Colorado River Yuman, and Verde Valley plain and redware ceramics, with "trade" pottery from the Cohonina, Kayenta Anasazi, Hopi, and Salt-Gila Basin Hohokam (McGuire, 1977; H. Yaeger, personal communication; personal observation). This range of ceramic types is often encountered in Prescott Branch sites from other areas (e.g. Ward, 1975), but nowhere else in the branch is the occurrence of non-Prescott materials so common. There are also small agricultural homestead colonies of Verde Valley Hohokam of late Camp Verde-early Honanki Phase (personal observation), and what appear to be early Cohonina pithouses. The situation involves active colonization by other groups and may also involve "trade", periodic use, temporally overlapping occupations, population mixing, or any or all of these. The single excavation in this northern area (Euler, 1962) does not support a view that the various traditions represented here were contemporary, but rather that the area was occupied by different groups at different times. However, the association between materials from various sources on several sites in this area is so strong and so consistent that if a serial occupation by different populations is postulated, some mechanism has to be conceived that would account for at least three archeological traditions which originated in distinctly different environments consistently occupying the same site locations and constructing the same architectural and agricultural features. It would seem more reasonable to assume a single sedentary, agriculturally based (Prescott Branch) population with a variety of "trade" contacts, interacting with one or more transient hunting and gathering populations, and supplemented by occasional small colonizing or homesteading groups from other areas, all occupying and utilizing the area more or less contemporaneously at least during one or more periods of overlap. At any rate, the situation here as it is known at present is far too complex, too little studied, and too lacking in controlled excavation to attempt any further explanation at this time. The area to the south, that is, southwest of Prescott, is even less well known.

Cultural History in the Study Area

To summarize the culture history of the study area, all that can be said on the basis of present evidence is that it was occupied by a Prescott Branch population, probably beginning at around 1100 A.D., with a few indications of earlier use or occupation dating to the Colonial Period. This occupation continued strongly until about 1300 A.D., when all recognizably Prescott Branch populations appear to have disappeared from their former territory, possibly moving south and east to join Agua Fria or Middle Verde populations. After this time, the dominant tradition, at least in the northern part of the Prescott Branch area, was Cerbat. At the time of contact, ca. 1860-1870, the area was occupied by the Hualapai in the north, approximately from Walnut Creek west, and the Yavapai in the south, on the Middle Verde and Agua Fria Rivers (Schroeder, 1960). These groups are probably directly descended from the earlier Cerbat occupation.

Cultural Manifestations in the Chaparral Type

The chaparral vegetation type in various associations and compositions covers approximately 4 million acres of land in Arizona, about half of which is held by the National Forests, primarily the Prescott and Tonto National Forests (USDA, 1975). At present, little is known about prehistoric cultural manifestations and patterns of land use in these chaparral areas, though certain localities are known to contain a high site density. Several of these have received some archeological attention, such as the Payson area on the Tonto National Forest (Dittert, 1976, 1977; Hanson, 1976; Wood and McAllister, 1976), and the Copper Basin (Jeter, 1977), Battle Flat (Wood, 1978a), and Camp Wood areas (Austin, 1978; Euler, 1962; Wood, 1978b; this report) on the Prescott National Forest. Others, such as Brushy Basin or Bloody Basin on the Tonto National Forest have received little or none. What has been recorded so far in this type has been patterns of material and development very similar to that described here--partial masonry pithouses associated with hilltop sites ("forts" in western Arizona, compounds and open multiroom "pueblos" in central Arizona)--with occasional to common remnants of agricultural structures for runoff manipulation, in a settlement pattern focused on agriculturally useful soil types. These materials represent the development of several different but related locally adapted upland socioeconomic traditions in a single widespread environment, and can provide information on the land utilization potentials of various areas in central and western Arizona. As such, they are important to the understanding of cultural process as a whole and to the understanding of adaptive patterns and processes in parts of Arizona little used today. Any information that might be derived from a study such as this can therefore have widespread application throughout Arizona for both chaparral conversion and cultural resource management.

Management Background

Introduction

As mentioned above, no experimental studies have been made prior to this on the impacts of any form of chaparral conversion. However, an archeological impact assessment has recently been made for the Battle Flat Chaparral Conversion Demonstration Area on Prescott National Forest land in the Bradshaw Mountains (Wood, 1978a). Also in this Region is a continuing study of timber sale impacts, being conducted by Peter Pilles, Coconino National Forest Archeologist. Within this context, the Camp Wood study can be seen as part of a developing program of archeolgical site impact management.

Research Goals and Objectives

The primary goal of this study was to identify and assess the types and extent of disruption and/or destruction which take place on cultural properties as a result of conversion operations utilizing a bulldozer-type tractor and Marden Brush-Crusher. Three specific types of cultural properties were selected to be observed for effect: surface artifact scatter, surface architectural features, and subsurface artifactual materials. This was accomplished by means of comparative studies of these properties as they appeared before and after the crushing operation had impacted selected loci within a test site.

The basic purpose of this study, therefore, is to provide Forest Service land managers in the Southwestern Region with an accurate assessment of the types of impacts which can be expected to result from this form of mechanical treatment for brush conversion. Such information will hopefully facilitate project planning by identifying specifically what impacts and information losses may occur. This information will then be used to suggest guidelines or programs for the mitigation of these impacts to archeological sites in similar situations. These sorts of information, helping to make protection and preservation of the resource both easier and more effective, will serve to facilitate the manager's compliance with Federal law and regulations.

Implementation

Discussion of Problems

Surface artifacts and architectural materials on cultural properties in central Arizona have, of necessity, a long history of disturbance and modification by various land use practices, including grazing,

farming, logging, vehicle travel, mining, recreation, and pothunting. Added to this is an even longer history of impacts due to geomorphological changes such as weathering, erosion, and soil movement (creep), all of which serve to alter physical characteristics and/or locations. Sites located on hills or where soil and cultural material deposits are shallow, such as is the case in the study area, are especially subject to this alteration of behavioral contexts, since these surfaces are the most vulnerable to geomorphological change, plant growth (root action), and human disturbance (McGuire, 1977). The goal of managing the cultural resource on Federal lands is the preservation of information (36 CFR 800). Protection from impacts should, therefore, be directed at preserving the integrity of behavioral contexts. Physical damage impacts to individual surface artifacts, constantly exposed to weathering, erosion, and transportation, are recognized as an important source of potential data loss, but artifact damage is seen as less important to understanding the majority of behaviors implied by artifacts than is damage to the patterns of associations, type percentages, spatial distributions, and structural features in which they are found. That is, until the artifacts are so badly damaged as to be unrecognizable. It seems more critical to assess impacts to the data-producing capabilities of sites in terms of alterations in the numbers and locations in which artifacts are found. Obviously, surface artifact damage is an impact to the data-producing value of a site and as such, it merits study and prevention (cf. Gallager,1977). However, it appears to be less of a factor in data loss than dislocation. It has been demonstrated by experiment that tractor travel over an archeological site is extremely destructive to surface artifact spatial relationships and locations (DeBloois, Green, and Wylie, n.d.; Gallagher, 1977), but a comparison of impacts indicates that surface artifact breakage by heavy mechanical equipment is markedly less frequent. Extrapolation of figures from DeBloois, Green, and Wylie (n.d.) indicates that an average of 70.0 percent artifact loss per sample resulted from displacement, while only 1 percent artifact loss overall was recorded as due to breakage. Structural damage to surface and subsurface architectural features, though not addressed in any known previous studies, can also be seen as considerably more destructive than individual artifact breakage, since it must involve alteration or loss of the behavioral contexts of artifactual materials.

In response to the problems and values discussed here, this study was designed to test what appeared to be the two most critical potential impacts expected from the use of the brush-crusher surface artifact and architectural component displacement and subsurface artifact breakage and displacement, taken as an indicator of all subsurface impacts.

Surface artifact damage was also recorded, in the form of breakage, taken as a simple means to represent all the various potential types of physical alteration which could be regarded as artifact damage. At this stage in the development of impact studies, it was felt best to emphasize the observation and assessment of impacts on the basis of damage or no damage to the presence/absence/distribution of cultural materials and architectural features, since these factors relate directly to a site's behavioral/informational integrity. Cultural remains are of little use or importance without a context made up of surface and subsurface features and patterns of material occurrence and association. A study of the type described here, while it may not be suitable for quantified predictions, will nevertheless allow generalizations to be made concerning the type of impacts to be expected in surface-disturbing chaparral management activities.

Design

This project was designed to be conducted in approximately four or five distinct stages (Wood and Yaeger, 1978), three of which are completed. The first stage was, of course, the inventory of cultural properties in the study area (Wood, 1978c). The second stage was the establishment of test situations and recording of cartographic and photographic data prior to the crushing operation. The third stage consisted of data recovery and observation immediately following the crushing operation. This report attempts to present the findings of that stage. However, after a "rest interval" of one or two years, during which natural recovery of the grass-seeded disturbed surface will be allowed to take place, a second comparative assessment will be made. This will constitute the fourth stage. It is felt that a comparison between the tests and controls cannot be sufficiently informative for predicting impacts until considerably more time is allowed to affect the control than the scant two months which passed between the layout and recovery of these tests. This long-term control data can be compared both to the original test data and to data from the tests as they are allowed to recover. At this point either a "final" report would be generated or, if it is decided to continue the study, an "interim" report will be prepared with recommendations for future study. The final goal of a prolonged study would be to continue observation of the tests and control at intervals of one to two years until the original or a converted vegetative cover is established and the scars on the soil surface have healed over. The appearance of a nearby crush after two years (Figs. 6, 7, and 8) indicates that final recovery may take well over five years. This continuing program would constitute the fifth stage. In this manner, some knowledge can be gained of both the short and long term effects of the crush.

As previously discussed, the test program was designed to observe three aspects of potential impact. The first two are fairly straightforward. These involved recording the displacement, breakage, addition, and loss of surface artifacts and structural components (wall stones) located within designated test squares. The purpose of using formalized test squares was to provide reconstructable observation units which would provide a focus for analysis. Recording was made by mapping and photography so as to allow comparative analysis of the appearance of the test features from before and after crushing. Test squares were all 1 meter by 1 meter and outlined during the photography to enable calculation of artifact displacement from the photos. The relatively small size of the test squares was chosen so as to provide an artifact inventory of workable size that would be readily identified and traced in the photographs as well as in the field. While a full photographic record of all tests was made, in accordance with the research design (Wood and Yaeger, 1978), not all photos are presented here. The short field time available to the study prevented crushing any more of the tests themselves, though it was originally intended to utilize the entire cultural/natural surface of the loci in characterizing impacts. Since these surfaces were not entirely crushed, fewer photos were needed to document changes in natural environment.

The third aspect of the study, briefly mentioned above, involved an investigation of subsurface impacts. To do this, a series of simple artificial test situations were constructed in the study area by burying sets of large and small ceramic flower pots (Korean manufacture) to simulate subsurface artifactual remains. These burials were made in areas around the other control and test loci which did not exhibit surface artifactual materials. Specific burial locations were selected according to considerations of soil texture and vegetative cover. Each burial contained two sets of pots at different depths. These depths were determined on the basis of excavation data from similar sites in similar environments (Euler, 1962; Jeter, 1977; Shutler, 1952; Ward, 1975), which indicated that cultural depth from the modern surface would average only 20 to 40 centimeters.

The final aspect of the program, not actually a test, involved the production of a short videotape of the testing and crushing operation. This videotape, now in production, attempts to record, or at least recreate, the establishment of the test situations and documents the crushing in such a way as to graphically and dramatically portray the disturbance impacts of this activity as they are taking place. It also documents the immediately observable impacts to the tests, including the recovery of the pot burials. Once finished, it should provide a valuable and effective training tool for the education of Forest Service and other agency personnel, and could serve as the basis for a larger production or series documenting the impacts to cultural resources resulting from a variety of disturbance activities. Logging, chaining, road construction and betterment, prescribed burning, wildfire, pothunting, and recreation

use are a few examples of the types of impacts that could be portrayed and analyzed. It is felt that a program of this type, if initiated at the Regional level, could make a valuable contribution to cultural resource management in the Nation as a whole.

Layout and Recovery of Tests

General Considerations

The four loci described above were selected according to the needs of the investigation as outlined in the research design (Wood and Yaeger, 1978), the logistical constraints of the machinery, and the tight time schedule and budget, though these latter considerations by no means excuse any fault in the program. The three test loci were chosen in close proximity to the only road into the crushing area, while the control locus was situated some distance away from it (Fig. 9). This arrangement facilitated communication and coordination with the machine operators during the crush and provided easy and rapid access to the tests afterwards. This proved especially valuable when trying to videotape the operation in an intermittent rain shower. The control locus was kept well out of view from any vehicular access to cut down on any artificial disturbance that might result from its increased visibility. In order to maintain it as a control, it was heavily decorated with brightly colored flagging so as to be avoided by the crusher. This same marking procedure was followed for all inventoried sites in the study area which were not selected for experimentation. As a final note, the original boundary of the study area was changed somewhat during the project in order to accommodate locus 19219 and part of 19221 (Fig. 9).

Control Locus - 19218

The location selected as a control for this study was a single-room rock-outlined (partial masonry) pithouse within AR-03-09-06-120 (see above; Figs. 9 and 18). It was selected because it contained a well-defined architectural feature, surface artifact scatter, and showed a strong dichotomy between areas with and without brush cover and having rocky or fine textured soils. These criteria were used for all test selections in the study. In addition, 19218 was chosen as control because it was most like the other loci selected. AR-03-09-06-113 or -215 could have easily been used, but both contained different architectural forms and somewhat different artifact inventories (Wood, 1978c). Layout of the test features was as follows:

1. A datum was established and permanently marked with a steel fencepost driven a little over one-half meter into the ground. The post was marked with a chromed steel tag embossed with the locus number, 19218. This datum, to remain in place until all phases of the study are completed, served as a locator for cultural features, test squares, and pot burials (see below).

2. A plane table map was made of the locus, depicting all cultural features, test squares, and pot burials in relation to the datum (Fig. 8)

3. Three test squares were laid out on the locus, each one meter on a side, arbitrarily oriented so as to incorporate desired features and artifacts.

Test square #1 containted a portion of the architectural feature, some light artifact scatter, and some brush cover over leaf-littered ground.

Test square #2 contained only surface artifact scatter under manzanita brush cover with leaf litter.

Test square #3 also contained only surface artifact scatter, but on bare ground with a gravel surface and no brush cover.

Two corners of each test square, those located on the side of the square nearest the datum, were marked by wooden stakes identified as to locus, square, and corner. The other tow corners were only temporarily marked with chaining pins and the perimeter was outlined with string for the photographs. After the photos were taken, the pins were removed and the stakes driven flush with the ground surface to leave as natural an appearance as possible.

4. A series of photographs were taken of the locus and of each test feature. Four cardinal views of the architectural feature were taken from a distance of about 5 meters with wide angle lenses (35 mm format). Four cardinal oblique views of each test square were then taken from a distance of 1.5-2 meters, using the same lenses. Finally, one overhead (nearly vertical) view was taken of each test square. This sequence of photographs was made on several different films--Kodak Plus-X Pan Black-and-White print; Kodacolor II color print; and Kodachrome 64 color slide. Two print films were used throughout the study to provide a maximum of visual data, as the two types record somewhat different characteristics. They were also used together to insure data recoverey in the event of catastrophe. This proved valuable when many of the black-and-white negatives were damaged by the contracted processor. The color transparencies were made to provide a display record of the project which could be used in conjunction with the videotape. This same procedure was followed at all study loci. A total of 19 photographs on each type of film were taken of the control locus.

Recovery of data from the control locus after the crushing operation had

taken place at the test loci consisted simply of re-establishing the test squares and rephotographing the locus using the same procedures as at the time of layout. Thus, the only impacts expected were time, rainfall, and the curiosity of other Forest personnel.

Architectural Test Locus - 19219

The location selected for this series of tests was a fairly well defined architectural feature with artifact scatter and little brush cover. Layout of test features was as follows:

1. A datum was established and marked in the same manner as for the control locus, designated 19219, and located in an area not to be crushed.

2. A plane table map was made of feature and test square locations (Figs. 9 and 19).

3. Two test squares were established on the locus, in the same manner as the control locus.

Test square #1 contained part of the architectural feature and some artifactual scatter. It has no brush cover.

Test square #2 contained surface artifact scatter and miscellaneous structural rocks believed to be displaced from the feature. It too had no cover.

Ground surface in both cases consisted of mixed fine soil and gravel.

4. A series of photographs were taken of the locus, consisting of four cardinal overviews of the architectural feature, four cardinal oblique views of each test square, one oblique view of each test square from the datum, and three overhead views (approximately east, south, and north) of each test square. This made a total of 20 photographs on each type of film.

Recovery of data after the crushing of the test features followed the same pattern as at the control locus, that is, a replication of the layout and recording procedure. The study crew remained on hand during the crushing to attempt to maintain visual contact with the test square corner stakes (unsuccessfully) and to taken additional photographs of the crusher in operation.

Surface Artifact Scatter Test Locus - 19220

This location contained a fairly dense concentration of surface arti-

factual material, situated west of the logging/access road opposite the architectural test locus (Figs. 9 and 20). It showed a strong dichotomy between brush cover and bare ground within a minimal area, as well as a wide variety of artifact types--sherd and lithic debris, manos, hammerstones, and a metate. Layout of test features was as follows:

1. A datum was established in the same manner as the others, marked with Tag 19220. This datum was also situated so as not to be crushed.

2. A datum-based map was prepared for the locus. Since no structural features were present, it consists only of a diagram of test square locations (Fig. 20).

3. Two test squares were laid out according to the established procedure.

Test square #1 contained surface artifact scatter on bare ground with no brush cover.

Test square #2 contained surface artifact scatter or a leaf-littered surface with brush cover supplied by an overhanging manzanita. Ground surface in both cases was again mixed fine soil and gravel.

4. A series of photographs was taken duplicating that from the architectural test locus. This involved 20 photographs on each film type.

Recovery of data after crushing followed the same procedure as at the architectural test locus.

Burial Loci

In order to test impacts to subsurface materials and features, a control and a test locus were selected within the site. The control burials were placed around the edge of the control locus, 19218, in areas without surface artifactual material, while a separate test locus was established for the test burials. This locus, 19221, was an area to the south of 19219 and 19220 which did not exhibit any surface artifactual remains (Fig. 9). Excavation of burial pits in both locations confirmed that no cultural material was present on or below the surface.

Burial Control Locus

Four burial tests were located here at points around the architectural feature at 19218 (Fig. 21), utilizing the same datum. It should be stated here that placement inside the architectural feature would also

have been desirable, but such a series of tests would have required at least partial excavation of these features, with the concommitant need for artifact analysis and storage. Thus, it was deemed beyond the scope of this small project. The layout of the burials was as follows:

Burial #1 was in fine-textured soil with no vegetative cover.
Burial #2 was in fine-textured soil with brush cover (manzanita).
Burial #3 was in rocky-textured soil without brush cover.
Burial #4 was also in rocky-textured soil, but one with vegetative cover (manzanita-oak-juniper).

The control burials were all set approximately 30-35 centimeters deep. Two sets of two flower pots each were placed in each hole, each set containing one large (6 inch diameter) and one small (4 inch diameter) pot, situatied vertically as they might be if sitting intact on the floor inside a buried architectural feature. The burial pits were located by reference to a wooden stake at the edge of each pit. These were in turn referenced to the locus datum (Fig. 21). The pots were packed with dirt removed from the pits, placed in the holes, and buried. Dirt was packed tightly around them using a small hand sledge and a post driver, taking care (successfully) not to damage the pots during burial. The entire amount of dirt removed from the pits was replaced in this manner, approximating the original contours and obtaining a degree of compaction comparable to that existing prior to excavation. After this was finished, an oblique view of each burial was photographed.

Recovery of the control burials was simple in that the pits were quickly located by means of the reference stakes. Once relocated, they were excavated and the pots photographed to document the changes produced by two months of burial.

<u>Burial Test Locus - 19221</u>

The four test burials were placed around a separate, newly established locus, designated 19221. A diagramatic map (Fig. 22) was prepared from this datum to describe the test locations. The burials introduced at this locus were laid out in the same manner as those at the control locus:

Burial #1 - Fine-textured soil, no cover.
Burial #2 - Fine-textured soil, brush cover (manzanita).
Burial #3 - Rocky-textured soil, no cover.
Burial #4 - Rocky-textured soil, brush cover (manzanita).

The brush type in all four "covered" burials used in the study was primarily or solely manzanita. While it was considered desirable to test several different species, the lack of time and money precluded any

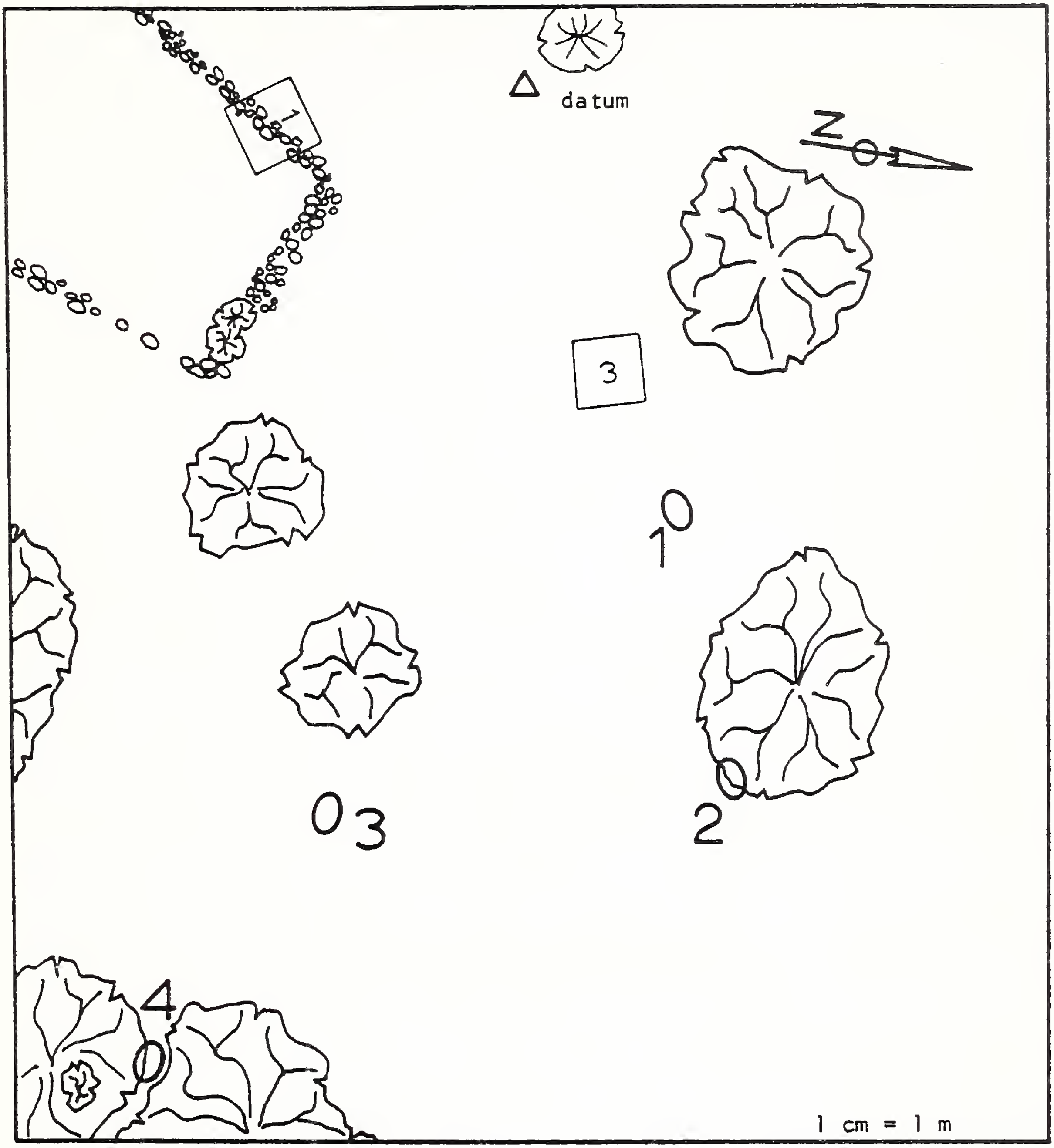


Fig. 21. Control Locus Burials - 19218

burial locations shown by numbered ovals

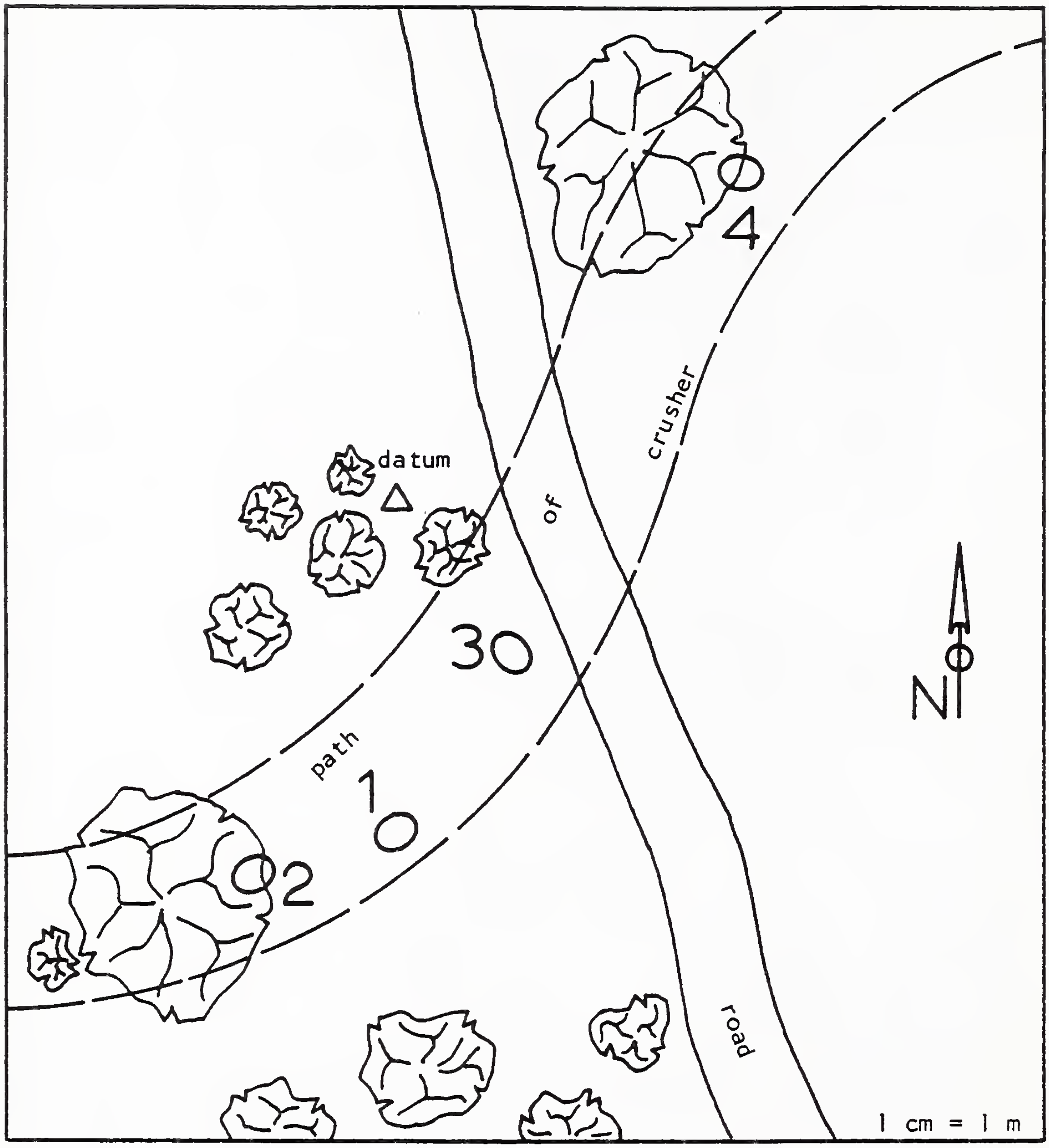


Fig. 22. Burial Test Locus - 19221

burial locations shown by numbered ovals

further sophistication. Therefore, manzanita, the most commonly occurring chaparral species in the study area, was selected for testing, in the hope of at least providing consistency. Other chaparral types will have to be tested at another time.

The test burials were set at bottom depths of 30-35 centimeters, in holes sterile of artifactual material. Again, two sets of pots were placed in each hole, following the same procedures as at the control locus. All but one of the pots were placed vertically. The upper level large pot in Burial #4 was placed on its side, in a belated effort to introduce more variability into the study. Upon completion, each burial was photographed, as at the control site.

Recovery of these burials was more difficult than was the case at the control locus, owing to relocation problems resulting from the surface disruption of the crushing operation. However, colored flags were placed on the pits to direct the crusher operator and these flags tended to resurface after the crushing. Combined with the battered and buried wooden stakes, these flags allowed fairly rapid identification of the burial pits. The recovery of pots from each burial was photographed (and videotaped) while in progress and after completion.

The Crushing Operation

The crushing operation which formed the basis for this study was part of an ongoing program of chaparral and juniper conversion in the northern part of the Prescott National Forest. This particular operation was a cooperative effort on the part of the Forest and the Arizona State Department of Game and Fish.

The Marden device utilized in this study was pulled by a bladeless (and somewhat ancient) D7H Caterpiller tractor, on which was mounted a small gasoline-engine seeder (Fig. 23). In this configuration, the machinery combines crushing, site preparation, and the seeding of range grasses into a single operation.

The strategy utilized by the operators was representative of standard Marden crushing procedures. It involved a series of more or less concentric passes through the treatment area. Those areas which were too steep for the tractor-Marden combination (about 20-30 percent slope) were avoided, as were areas where the vegetative cover was primarily trees, and those areas that were too rocky. The susceptibility of Marden blades to rock impact was demonstrated when two blades were broken in a single day during the test. The end result of this strategy was a more or less natural-appearing mosaic of pine-oak stringers, brushy hillsides and outcrops, and crushed flats which will eventually be grassed over. Such an arrangement is extremely beneficial to wildlife, as it increases the diversity of habitat while retaining cover and providing more "edge."

Fig. 23. Marden Device in Operation

The working of a Marden device appears at first glance to be utterly simple, but it is composed of a series of different actions. As the leading roller passes over the brush, the hardened edges of the blades break, cut through, and flatten branches and stems. The rolling of the drum causes the blades to pivot in the ground, churning and transporting surface soil. This action also helps to cut, crush, and grub out root crowns. The second roller, while doing the same things to the material prevously crushed by the front roller, imparts a degree of eccentric motion (when traveling in a straight line or in a right turn) owing to the offset bolted into the frame. The second roller, then, repeats the actions of the first with a slightly different angle of attack. Finally, to prevent the device from rolling too easily over the brush, the blades on each roller are of two different widths. This tends to produce an up-and-down motion which increases impact. This combination of actions usually leaves behind small, shattered pieces of brush scattered across and mixed into the upper soil surface. The soil itself is often heavily churned, loosened, broken up, and aerated. It is often left in a series of well-defined ridges and furrows, especially in soft soil, which mark the points of blade penetration. As can be seen in Figs. 6 and 8, these furrows can remain visible for several years. The soil surface left behind after crushing--opened up with a layer of fresh organic matter--provides a good seedbed for the establishment of grasses. However, repeated Marden travel over an unprotected surface eventually turns it to powder. Obviously, the use of this device has a serious potential for disturbing or destroying cultural resources.

However, the effectiveness of the device, and thus, its impact on cultural resources, is highly variable and it is not always as efficient as just described. With dry brush such as manzanita over relatively fine-textured soil it is very effective. It does not work as well on "springy" vegetation such as young junipers or on any chaparral species immediately after a good rain. In these situations, it merely pushes the plant over, bending it into the ground and flattening it out, without necessarily ever cutting through the plant and penetrating the surface. When soil and vegetation conditions allow, blade penetration can be quite deep, with rollers sinking the full width of the blades into the ground (Fig. 24). On rocky soil, or above shallow bedrock, penetration is minimal and there is little or no churning of the soil. In addition, rocks dull and damage the blades, reducing their effectiveness. Thus, a variety of surface and subsurface environmental factors must be considered when assessing potential damage to cultural resources.

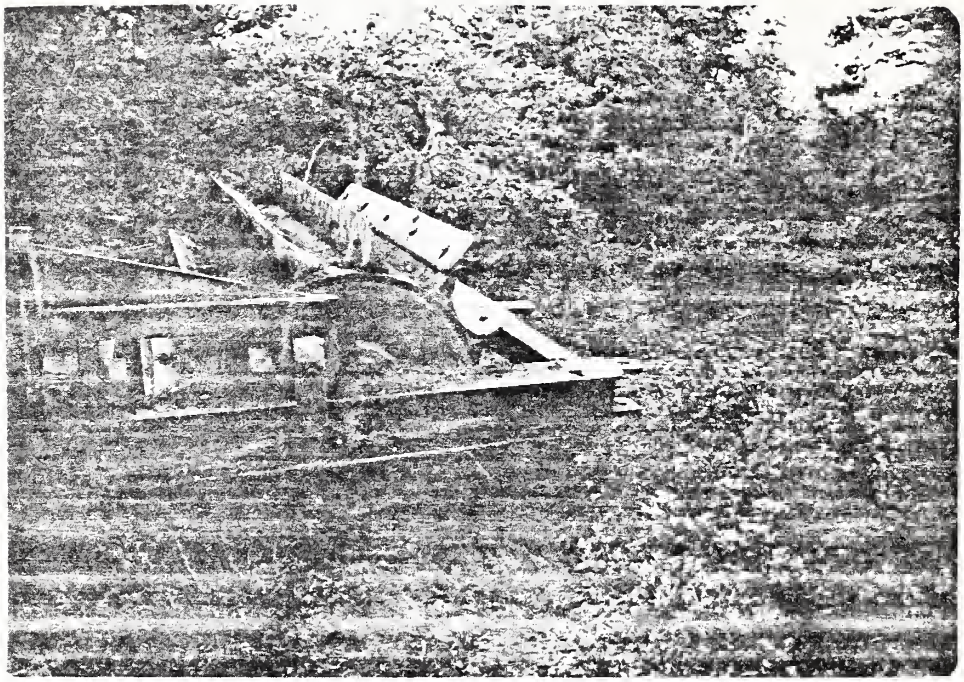


Fig. 24. Marden Device in Operation, Showing Depth of Penetration in Bare, Fine Soil.

Fig. 25. Overview of 19218 Taken At Time of Layout

Analysis and Observations

Control Locus

Overview - The major change in the control locus observed at the time of crushing is that there had been an increase in foliage on the plant cover of the site. This is apparent in the photographs taken at the two visits (Figs. 25 and 32), and appears to have been most noticeable on the manzanita. This was probably due to relatively frequent rainfall in the period of time between layout and testing. Surface leaf, branch, and needle litter had not changed appreciably, though bare soil areas appeared to have been washed by rainfall and runoff which obliterated old footprints and other signs of disturbance (Figs. 26-28 and 33-35). There was some transport of pine needles and other light materials into and out of the test squares, but not much in the way of soil/sediment transport was observed.

Test Squares - The observations described below are based on the comparative analysis of the photographs taken at the time of test feature establishment and again at the time of testing. Other observations made in the field will be noted only for the purpose of clarifying elements in the photographs.

Test Square #1 - Five artifacts were identified in the layout photograph (Fig. 29), all of which were sherds (three Prescott Black-on-plain, two Aquarius Orange). These same five sherds were identified in the test photograph with no apparent displacement (Fig. 36). One Black-on-plain sherd was broken, however, probably by curious Forest personnel visiting the test area. There was apparently no displacement of litter cover in the test square. One rock out of the 15 identified as structural in the layout photo was displaced in the test photo, but this was done purposefully in order to place the corner stake. No other structural changes were noted, either in the photos or in the field. Results of the analysis are shown in Table 1.

Test Square #2 - Seven artifacts were identified in the layout photo, all of which were Prescott Plain and Aquarius Orange sherds (Fig. 30). Only 6 were present in the test photo (Fig. 37), but the seventh was identified in the field, the "change" owing to a slightly different camera angle and lighting. No displacement of or damage to the artifacts was noted, nor was there any apparent change in the soil cover. Results of the analysis are shown in Table 2.

Test Square #3 - This test square showed the most change over time of any feature at the test locus (Figs. 31 and 38). Rainfall/slopewash was the apparent cause of the effect, which was more pronounced here owing to a lack of vegetative or litter cover. There was also a single mule deer track, though its

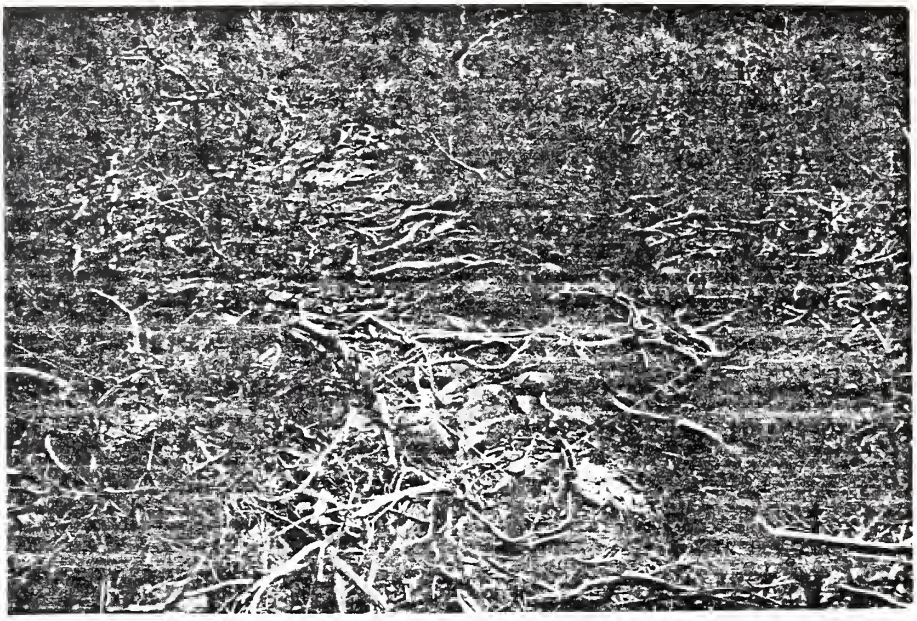


Fig. 26. Oblique View, Test Square #1, 19218 (Layout)

Fig. 27. Oblique View, Test Square #2, 19218 (Layout)

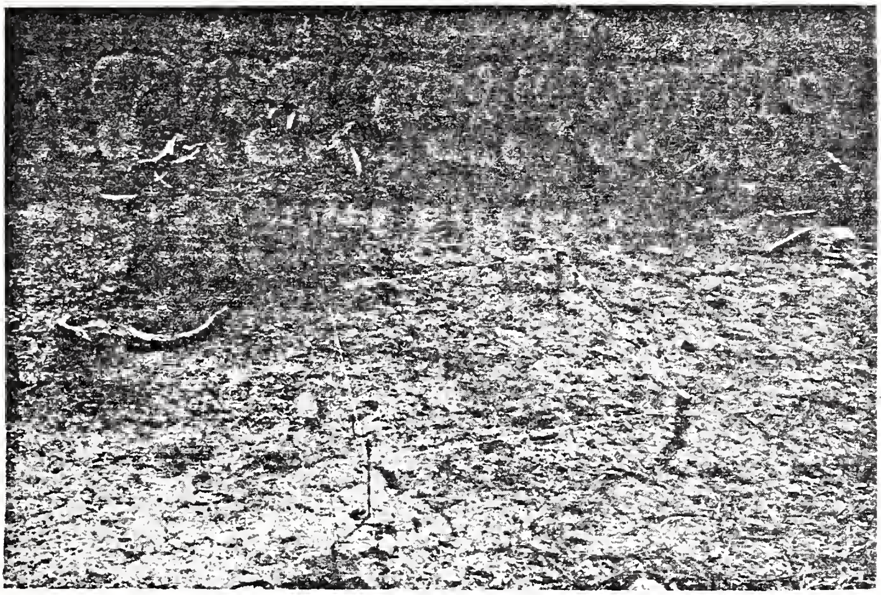


Fig. 28. Oblique View, Test Square #3, 19218
(Layout)

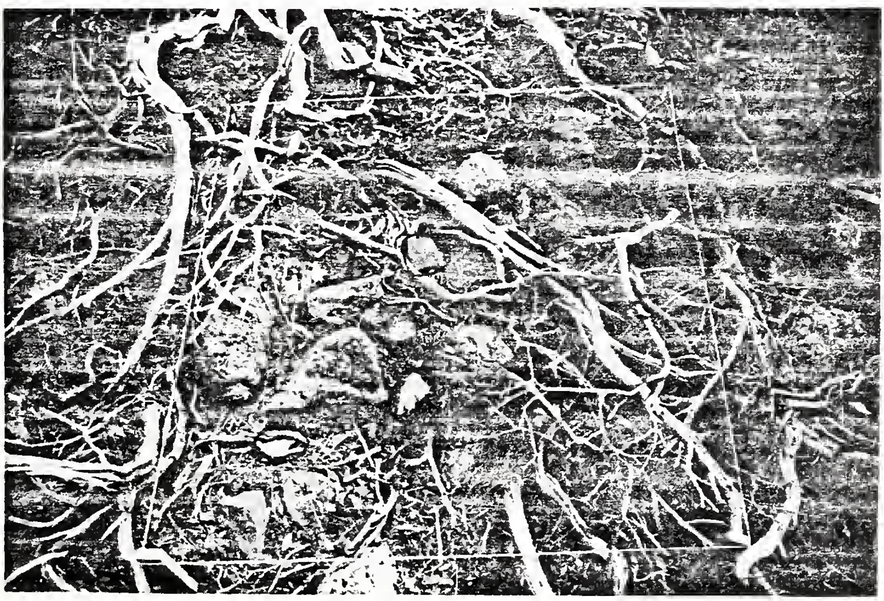


Fig. 29. Overhead View, Test Square #1, 19218;
Taken at Layout, Artifacts Circled

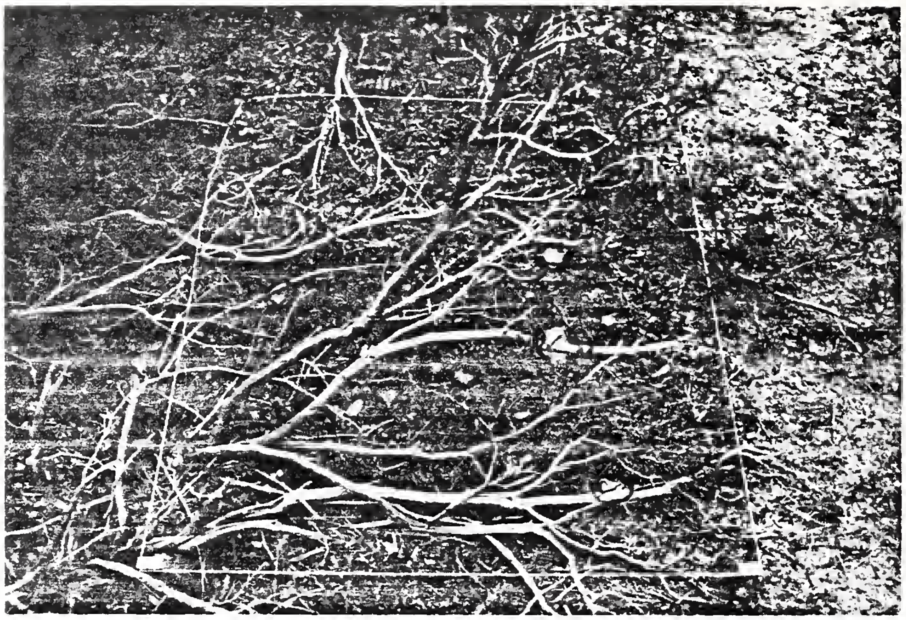


Fig. 30. Overhead View, Test Square #2, 19218; Taken at Layout, Artifacts Circled

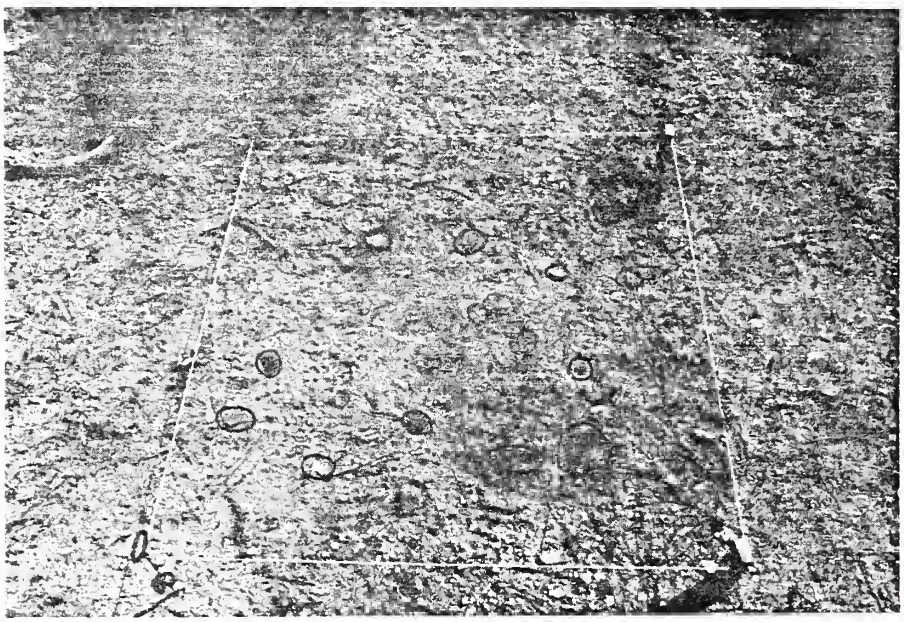


Fig. 31. Overhead View, Test Square #3, 19218; Taken at Layout, Artifacts Circled

Fig. 32. Overview of 19218
Taken at Time of Recovery

Fig. 33. Oblique View, Test Square #1, 19218
(Recovery)

Fig. 34. Oblique View, Test Square #2, 19218
(Recovery)

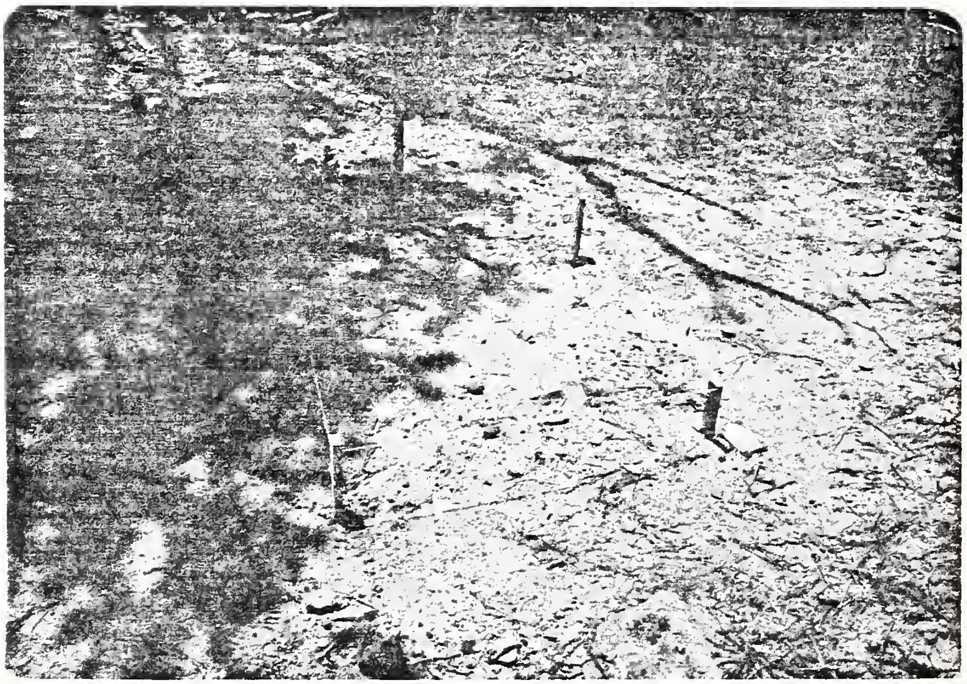


Fig. 35. Oblique View, Test Square #3, 19218
(Recovery)

Fig. 36. Overhead View, Test Square #1, 19218; Taken at Recovery, Artifacts Circled

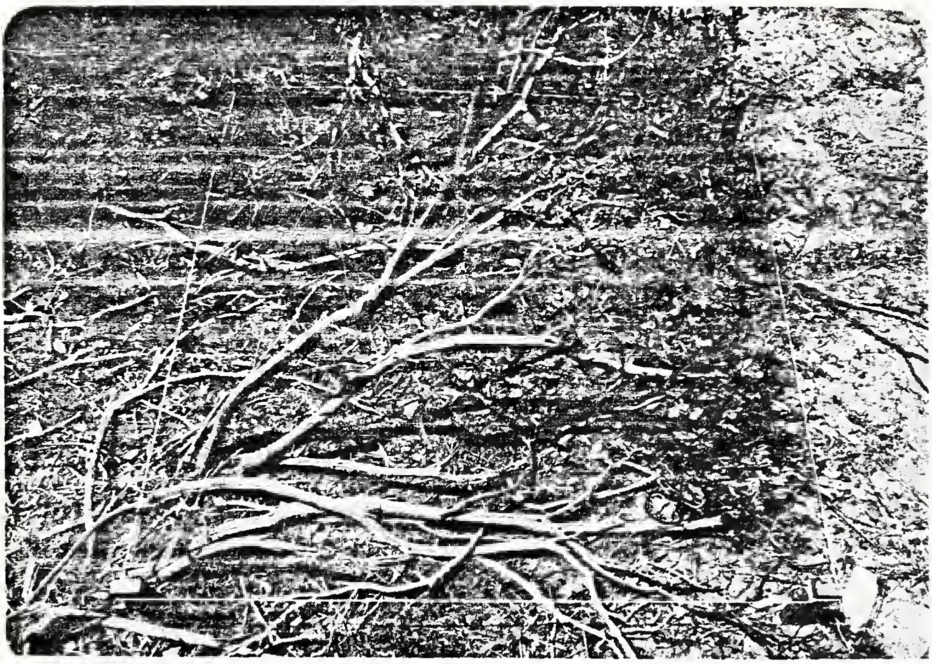


Fig. 37. Overhead View, Test Square #2, 19218; Taken at Recovery, Artifacts Circled

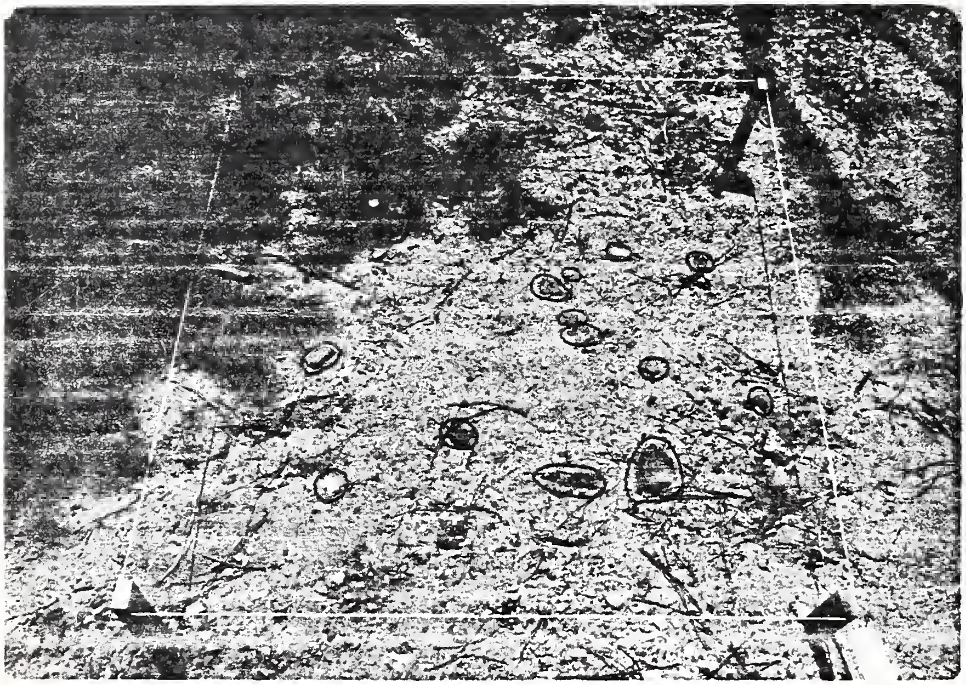


Fig. 38. Overhead View, Test Square #3, 19218;
Taken at Recovery, Artifacts Circled

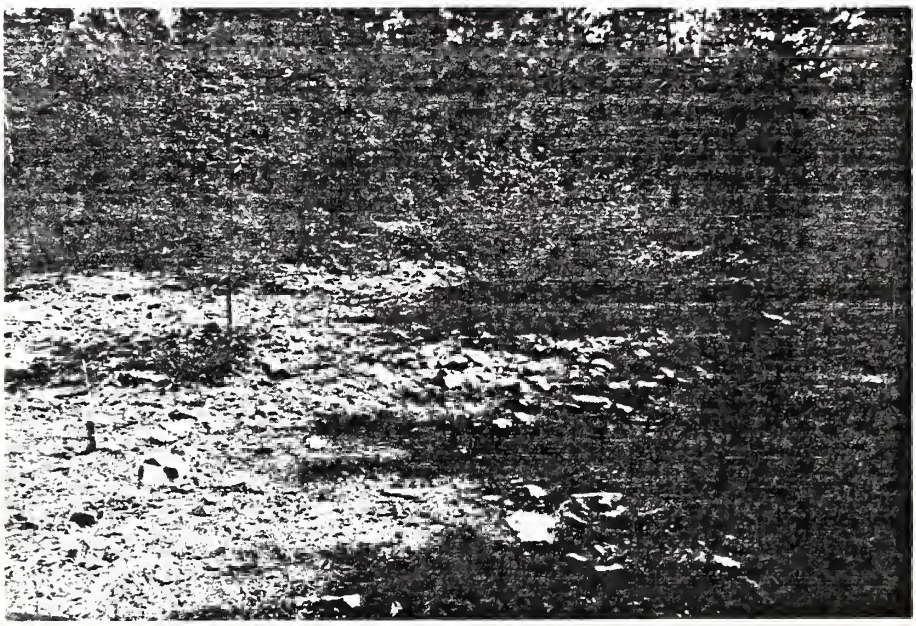


Fig. 39. Overview of 19219,
Taken at Layout

Table 1. Control Locus Impacts - Test Square #1

Artifacts

Impact	No.	%-age
Displacement	0	0
Breakage	1	20
Loss	0	0
Addition	0	0
Original No. Artifacts in Square	5	
Total Number Impacted	1	
Overall impact to original inventory		20%

Structure

Impact	No.	%-age
Displacement	0	0
Breakage	0	0
Loss	0	0
Addition	0	0
Original No. Structural Components	15	
Total Number Impacted	0	
Overall Impact to Original Inventory		0%

Table 2. Control Locus Impacts - Test Square #2

Artifacts		
Impact	No.	%-age
Displacement	0	0
Breakage	0	0
Loss	0	0
Addition	0	0
Original No. Artifacts in Square	7	
Total No. Impacted	0	
Overall Impact		0%

effect must be considered minimal. The square contained 16 artifacts in the layout photo: 9 sherds of Prescott Plain or Aquarius Orange, one sherd each of Prescott Black-on-plain and Aquarius Black-on-orange; 4 lithics, two of chalcedony, two of basalt; and one piece of unworked turquoise. In the test photo, the number of artifacts was unchanged and the lithics were unaffected, but one new sherd was added and one original sherd was lost (both plainware). There was some displacement of materials, though not in any measurable amount as it consisted mostly of rotation in place. The large jar rim sherd of Prescott Plain was broken, probably having been stepped on by person or animal unknown. Finally, the turquoise fragment was displaced upslope, probably by visiting Forest Service personnel. Surface litter patterns had changed, but not greatly, as it continued to show a thin, more or less random scattering of pine needles. Results of the analysis are shown in Table 3.

The overall impression gained from the analysis of test squares at the control locus is that alteration due to natural causes, at least over short periods of time, is dependent on available natural protection from the mechanisms of that change. Rainfall and runoff modified the inventory of test square #3, but did not affect test squares #1 or #2. Both of these squares had relatively heavy plant cover and surface litter. This indicates what would appear to be intuitively obvious--that bare soil surfaces are more susceptible to alteration of artifact inventory by erosional agents such as those noted here than are those protected from rainfall and runoff by vegetation cover.

Architectural Test Locus

Overview - Essentially no change was observed in the locus between layout and testing other than that due to crushing (Figs. 39-41, 45, and 48).

Test Squares - The observations described below are based on the comparative analysis of the study photographs. Other observations will be noted as necessary.

Test Square #1 - Figure 44 shows the square as it was being crushed. Blade penetration as observed at the time was low, only about 2-6 centimeters (Fig. 45), owing to the surface rocks. Turning of the soil was, therefore, minimal and the areas between blade furrows were relatively undisturbed. Twelve artifacts were observed in the layout photo (Fig. 42). All were sherds of Prescott Plain or Aquarius Orange, with one of Prescott Black-on-Plain. In the test photo (Fig. 46), only five of these could be identified. One of these was displaced but was still visible within the square. None

Table 3. Control Locus Impacts - Test Square #3.

Artifacts

Impact	No.	%-age
Displacement	1	6.25
Breakage	1	6.25
Loss	1	6.25
Addition	1	6.25
Original No. Artifacts in Square	16	
Total No. Impacted	4	
Overall Impact to Original Inventory		25%

of those visible in the test photo were broken and none were added. There were 20 "structural" rocks in the layout photo. The test photo showed that two had been lost and six displaced by being rotated and/or pressed into the ground by glancing or direct contact with the blades. None were broken, however, and the hard quartz showed little contact damage. No new rocks surfaced. The results of the analysis are shown in Table 4.

Test Square #2 - The crushing of this square is shown in Figure 47. This test square had fewer rocks on its surface, so that blade penetration was deeper--about 10-20 centimeters. This resulted in a higher degree of mixing and churning of the surface soil. Nearly the entire surface of the square was disturbed, save for one small, rocky corner (Fig. 48). Even a small shrub was disturbed by the blades and displaced into one corner of the square. One of the three structural (?) rocks originally in the square was displaced while the other two were lost.

Two (structural?) rocks from outside the square were removed from their original locations and deposited inside, while a third surfaced apparently from inside the square. Eighteen artifacts were originally identified inside the square (Fig. 43), including 16 plainware sherds, one lithic, and one quartzite ground stone fragment of unknown character. Only four artifacts were observed after crushing and only one of these was original--the ground stone fragment (Fig. 49). No damage was noted on the remaining original artifact, but fresh breakage was noted on all three newly surfaced sherds. The ground stone fragment was displaced approximately 45 centimeters, according to the photographs. The results of this analysis, shown in Table 5, indicate that as the density of structural material on the surface decreases, less obstruction to blade penetration is encountered and individual artifact displacement may be potentially greater.

Observations - Structural Impacts

The overall impression of Marden impact to structural remains is that it is dependent on how much rock shows on the surface and on where and how the blades contact it. A straight-line pass over a well-defined but deeply imbedded structure does comparably little damage to the structure (probably the case in test square #2) but results in more damage, as the blades penetrate deeper, turning more of an arc in the ground. This gives the blades more leverage and churns more of the surface as disturbance arcs overlap (Fig. 50). The structural displacement distances observed in the test square #1 were small, in the range of 2-10 centimeters. However, if combined through several overlapping passes, especially when contact is made with previously

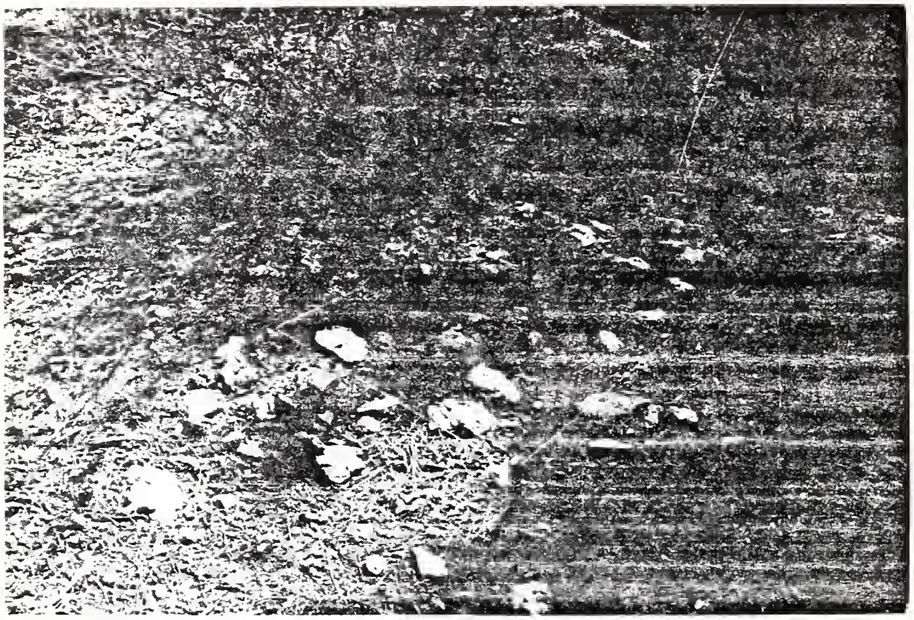


Fig. 40. Oblique View, Test Square #1, 19219
(Layout)

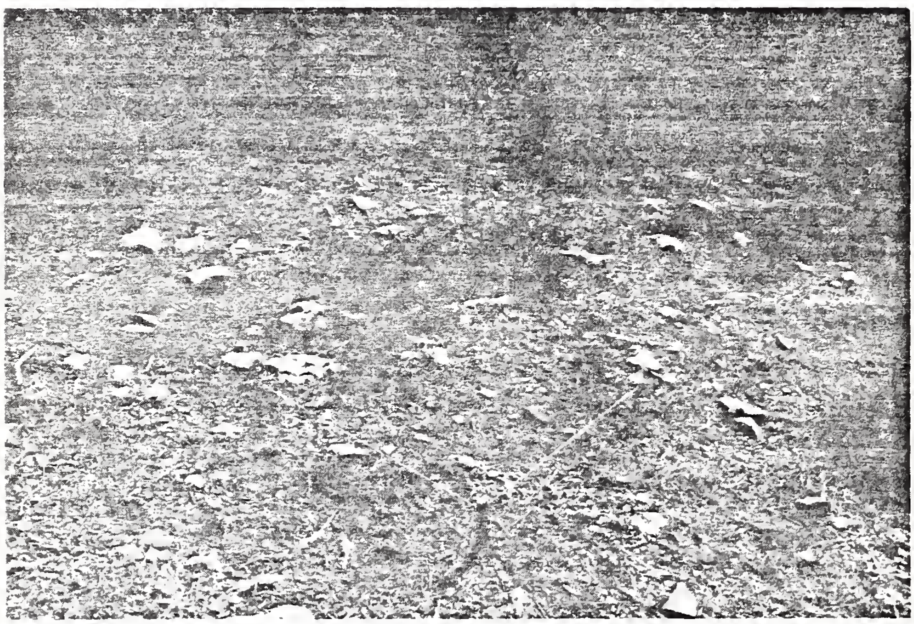


Fig. 41. Oblique View, Test Square #2, 19219
(Layout)

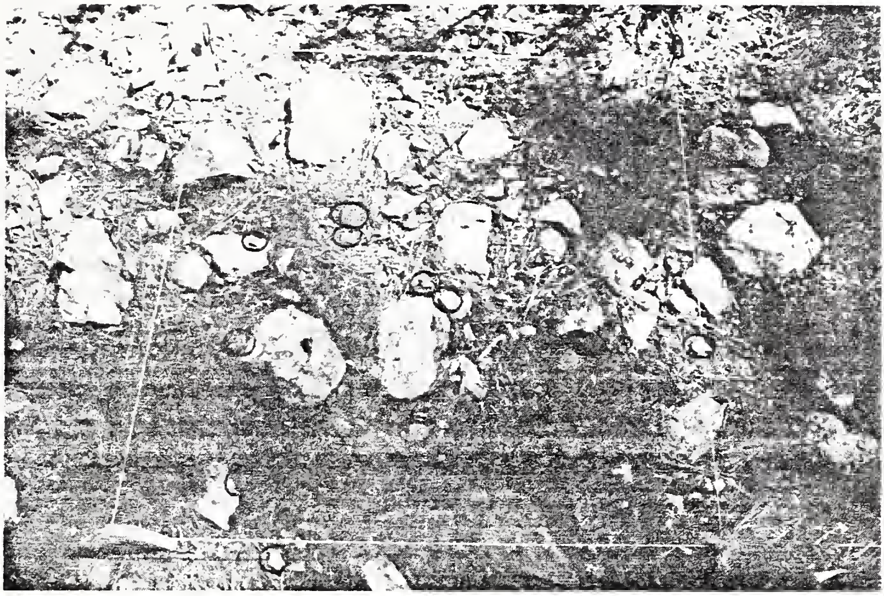


Fig. 42. Overhead View, Test Square #1, 19219;
Taken at Layout, Artifacts Circled

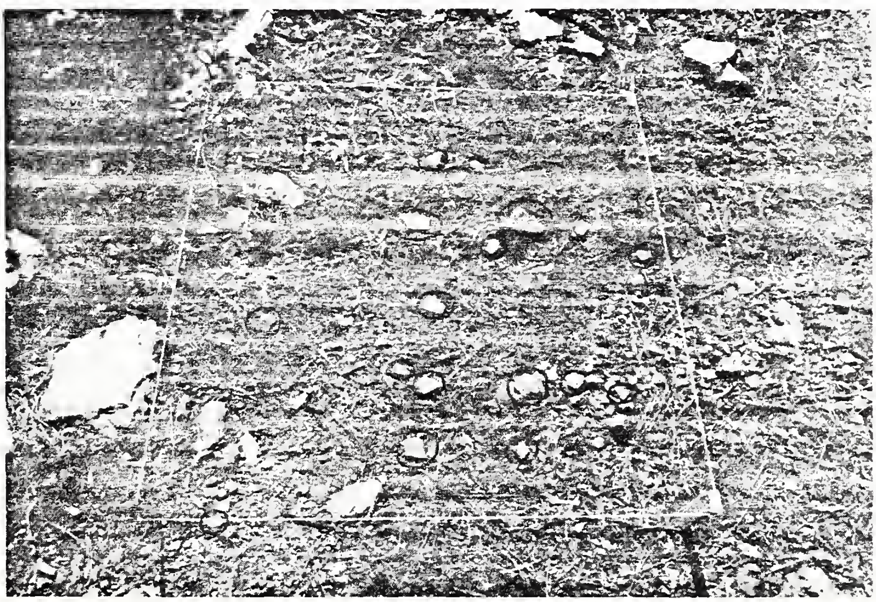


Fig. 43. Overhead View, Test Square #2, 19219;
Taken at Layout, Artifacts Circled

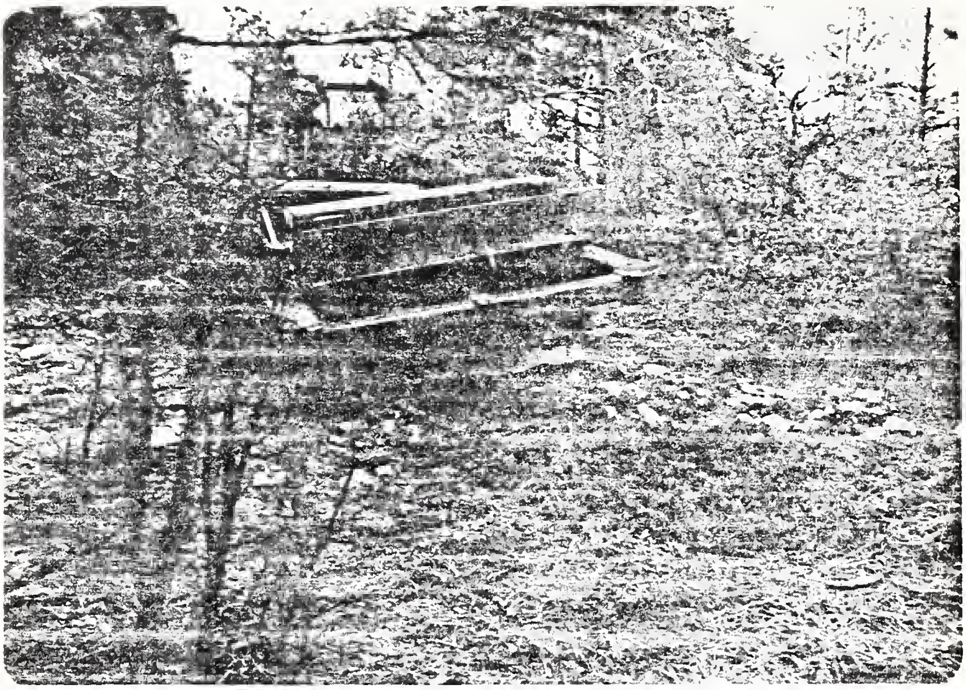


Fig. 44. Test Square #1, 19219
Being Crushed

Fig. 45. Oblique View, Test Square #1, 19219
(Recovery)

Fig. 46. Overhead View, Test Square #1, 19219; Taken at Recovery, Artifacts Circled

Fig. 47. Test Square #2, 19219 Being Crushed

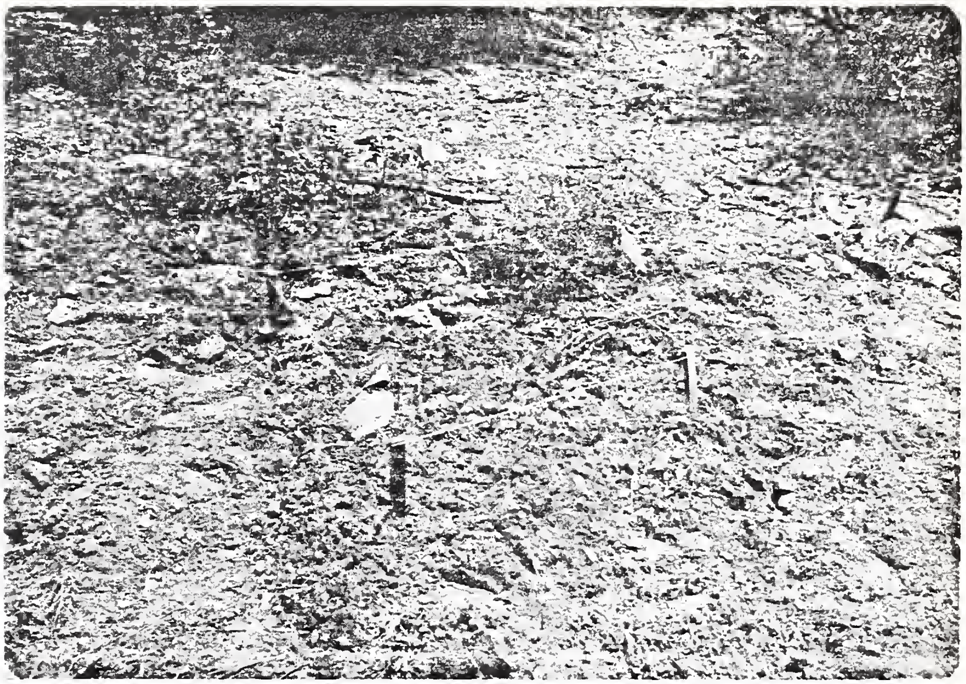


Fig. 48. Oblique View, Test Square #2, 19219
(Recovery)

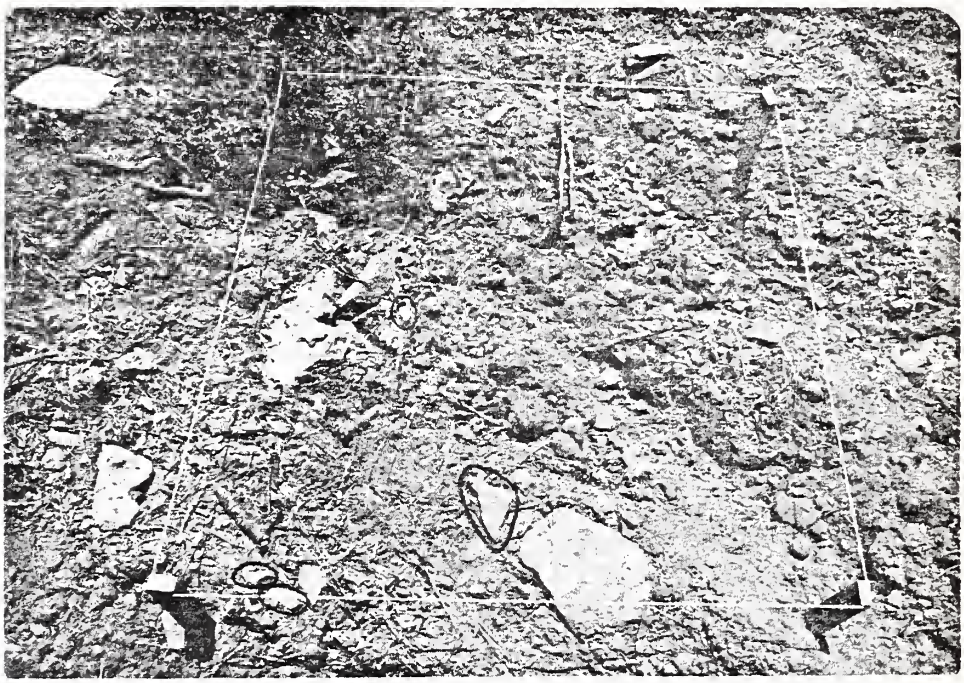


Fig. 49. Overhead View, Test Square #2, 19219;
Taken at Recovery, Artifacts Circled

Table 4. Architectural Test Locus Impacts - Test Square #1

Artifacts

Impact	No.	%-age
Displacement	1	12.5
Breakage	0	0
Loss	7	87.5
Addition	0	0
Original No. Artifacts in Square	12	
Total Number Impacted	8	
Overall Impact To Original Inventory		66.7%

Structure

Impact	No.	%-age
Displacement	6	75
Breakage	0	0
Loss	2	25
Addition	0	0
Original No. Structural Components	20	
Total Number Impacted	8	
Overall Impact To Original Inventory		40%

Table 5. Architectural Test Locus Impacts - Test Square #2

Artifacts

Impact	No.	%-age
Displacement	1	4.2
Breakage	3	12.5
Loss	17	70.8
Addition	3	12.5
Original No. Artifacts in Square	18	
Total Number Impacted	18	
Overall Impact To Original Inventory		100%

Structure

Impact	No.	%-age
Displacement	1	20
Breakage	0	0
Loss	2	40
Addition	2	40
Original No. Structural Components	3	
Total Number Impacted	3	
Overall Impact To Original Inventory		100%

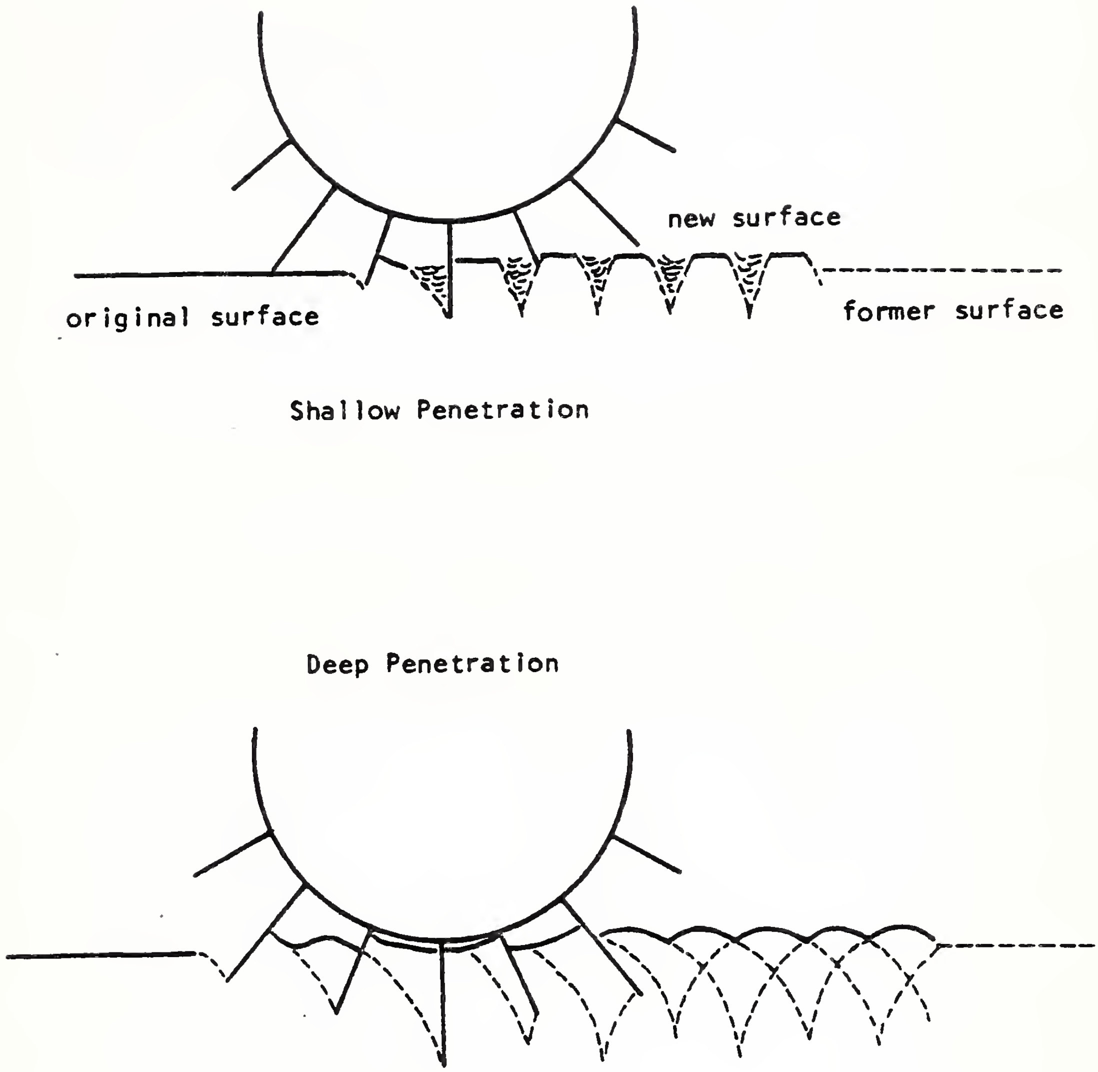


Fig. 50. Relative Soil Churning Resulting from Deep and Shallow Blade Penetration (diagrammatic)

displaced stones, movement of materials will probably increase as access to the soil is increased. Displacement in test square #2, which did not contain enough surface rock to resist penetration, was much greater. It would appear that surface masonry structural remains protect both artifacts and structure integrity, but only as long as the stones are more or less flush with the ground and present an interlocking "mosaic" surface over which the blades will ride without penetration. Once the blades are able to penetrate between the rocks, their leverage is increased and displacment becomes markedly greater. On the other hand, solid rock surfaces are usually avoided because of their high potential for damaging the blades.

Surface Artifact Scatter Test Locus

Overview - Very little in the way of natural changes was observed here at the time of testing. Some increase in foliage was noted and a small, unidentified forb had grown up in the middle of test square #1 (Figs. 51-54, 57, and 58).

Test Squares - These observations are, again, based on photographic comparison, with other observations inserted where appropriate.

Test Square #1 - This square was located in an area of the locus which contained a relatively fine-textured mineral soil with no vegetative or litter cover. Blade penetration was observed as high, about 10-15 centimeters. Thirteen artifacts were identified in the layout photo: one granite metate, a vesicular basalt mano fragment, a basalt hammerstone, a chalcedony flake, and nine plainware sherds (Fig. 55). Only eight remained to be identified in the test photo (Fig. 59). No additional artifacts were encountered but those remaining, while not appreciably damaged, were displaced. The metate was nicked and scarred on both sides by blades passing over it. Soil churning by the blades then rotated it and left it tilted at a different angle. Despite the deep penetration, strips of surface were left relatively undisturbed between blade furrows, so that the only displacements and losses occurred within and at the edges of the furrows. Finally, the hammerstone was pressed into the ground but not damaged. The results of this analysis are presented in Table 6.

Test Square #2 - This square was located partially under the drip-line of a large manzanita on a litter-covered surface of fine textured humic loamy soil. Blade penetration here was deeper than at test square #1--about 15-25 centimeters--owing to the extreme

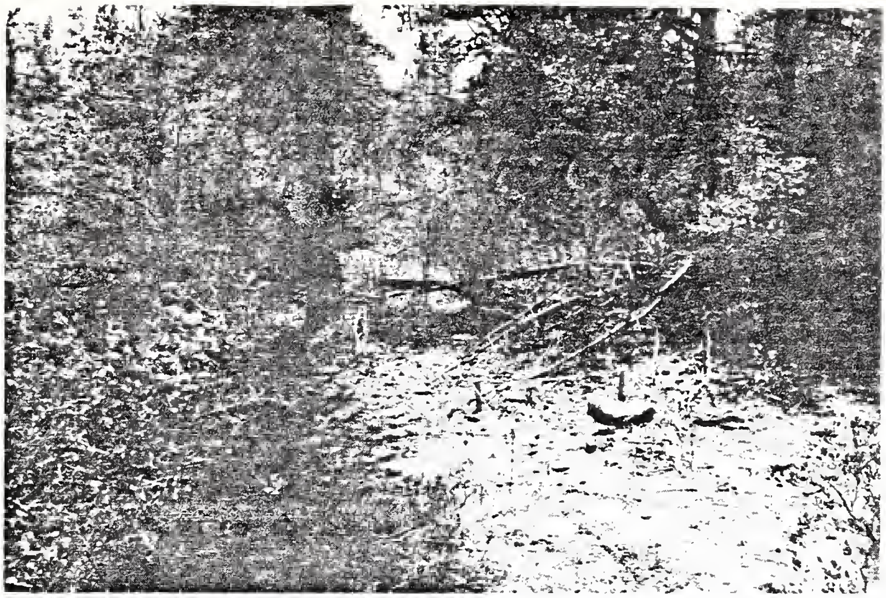


Fig. 51. Overview of 19220, Taken at Layout,
View South

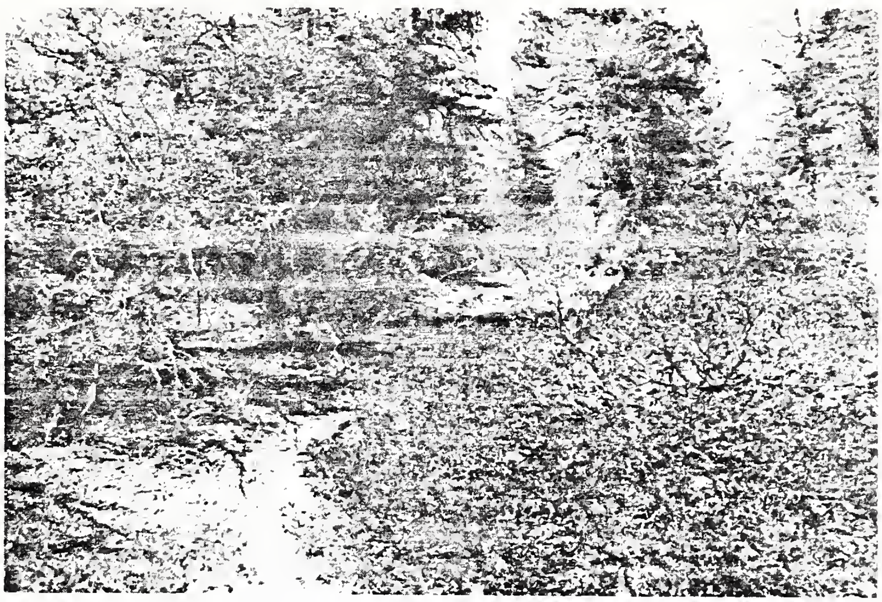


Fig. 52. Overview of 19220, Taken at Layout
View West

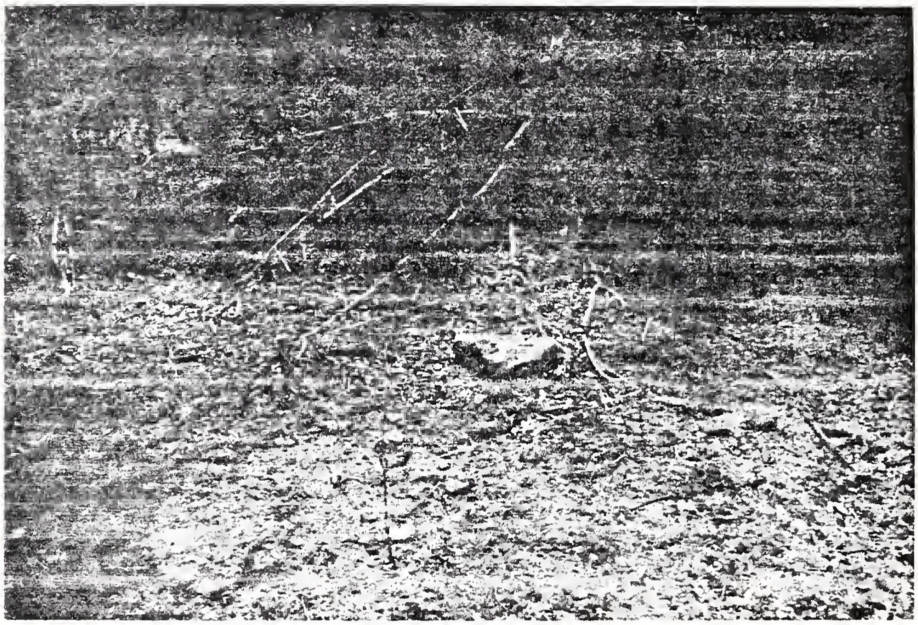


Fig. 53. Oblique View, Test Square #1, 19220 (Layout)

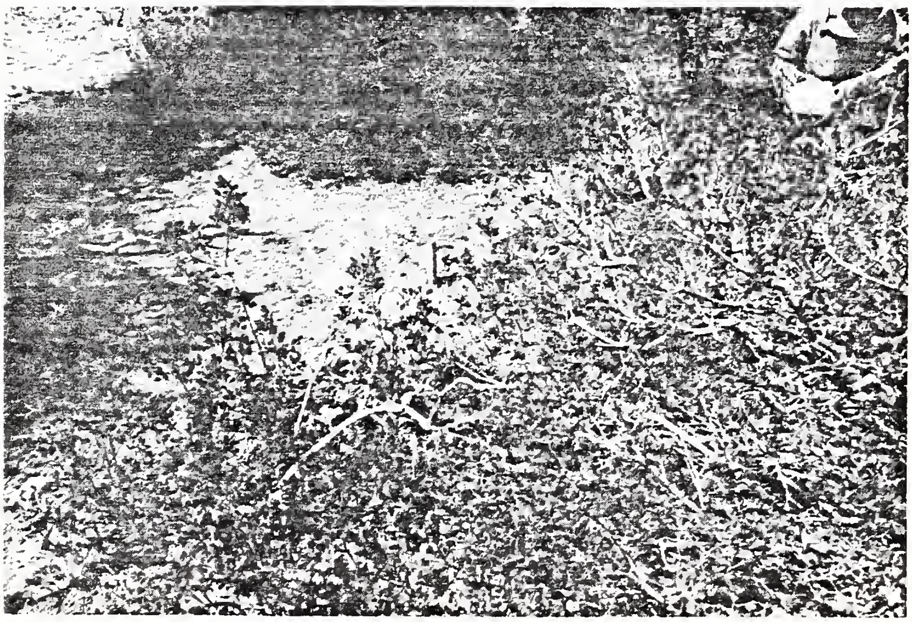


Fig. 54. Oblique View, Test Square #2, 19220 (Layout)

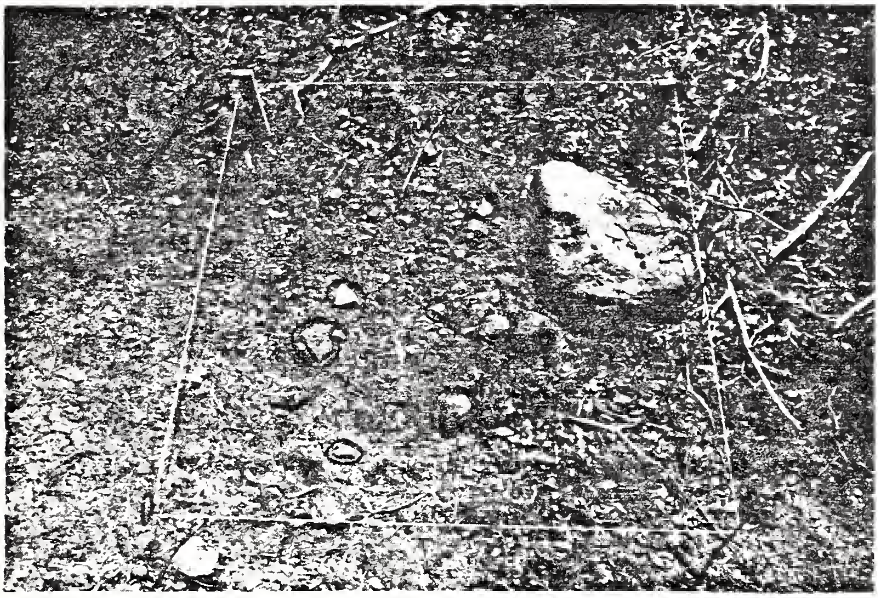


Fig. 55. Overhead View, Test Square #1, 19220; Taken at Layout, Artifacts Circled

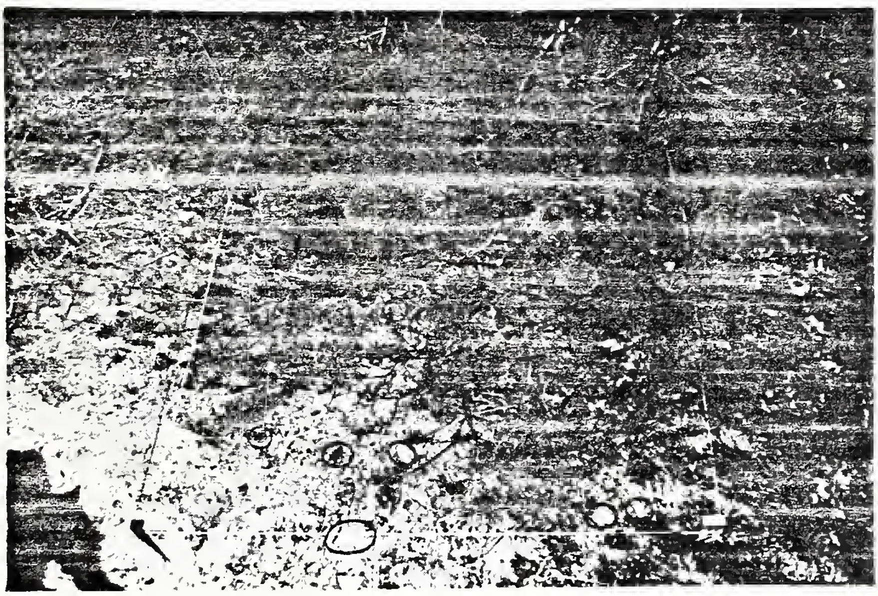


Fig. 56. Overhead View, Test Square #2, 19220; Taken at Layout, Artifacts Circled

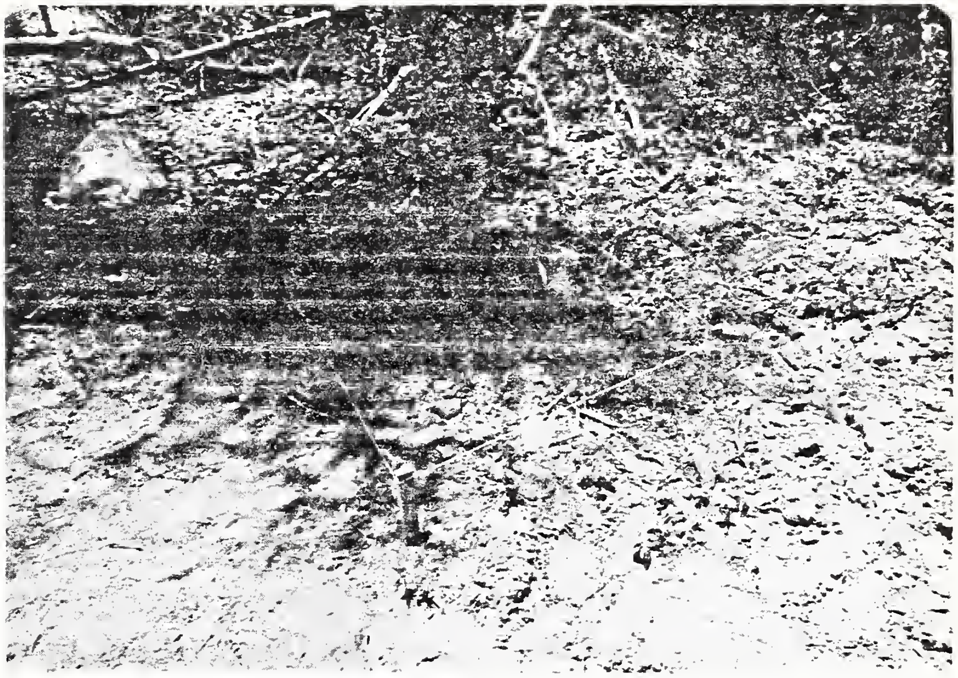


Fig. 57. Oblique View, Test Square #1, 19220
(Recovery)

Fig. 58. Oblique View, Test Square #2, 19220
(Recovery)

Fig. 59. Overhead View, Test Square #1, 19220; Taken at Recovery, Artifacts Circled

Fig. 60. Overhead View, Test Square #2, 19220; Taken at Recovery, Artifacts Circled

Table 6. Surface Scatter Test Locus Impacts - Test Square #1.

Impact	Artifacts No.	Artifacts %-age
Displacement	4	40
Breakage	1	10
Loss	5	50
Addition	0	0
Original No. Artifacts in Square	13	
Total No. Impacted	10	
Overall Impact to Original Inventory		76.9%

Table 7. Surface Scatter Test Locus Impacts - Test Square #2

Impact	Artifacts No.	Artifacts %-age
Displacement	4	25
Breakage	1	6.25
Loss	5	31.25
Addition	6	37.5
Original No. Artifacts is Square	9	
Total No. Impacted	9	
Overall Impact to Original Inventory		100%

softness of the ground. A considerable amount of mixing was observed in the square, produced both by blade movement and by broken brush carried by the blades. Nevertheless, thin, discontinuous strips of intact surface were left between furrows. Nine artifacts were identified in the layout photo (Fig. 56). These were: one obsidian lithic, one chalcedony lithic, and seven plainware sherds. Ten artifacts were identified in the test photo (Fig. 60). Four of these were original (the chalcedony lithic and two sherds, one of which was in two pieces), but all were displaced. Two other sherds were brought in from outside the square, and the rest of the original inventory was lost, replaced by what appeared to have been subsurface materials. The results of this analysis are presented in Table 7. Field observation of sherds brought to the surface by the crusher indicated a considerable amount of breakage (one or more freshly broken edges on each new sherd). Several sherds showed varying degrees of scoring, either from the blades or from churning rocks. The overall effect of the pattern of breakage was to standardize sherd size somewhat (to less than 6 square centimeters). This effect is similar to that observed in nearby heavily grazed areas. No lithic damage was identified.

Observations - Surface Impacts

It appears on the basis of field observations and photos from the locus, that soft, wet surfaces (it rained just prior to crushing) tend to allow more mixing of the surface, but reduce breakage by lowering resistance to materials being pursued through the soil.

The degree of mixing depended primarily on soil texture and cover. Even though both test squares contained relatively fine-textured soil, #2 was much finer grained, less compacted, and "softer," owing to a high percentage of humus. It was also apparent here that broken pieces of brush dragged through the ground surface not only increase mixing, but also change some of the disturbance patterning by extending it away from the blades. This was entirely contrary to prior expectations, but obvious once the device began to work. Therefore, where heavy artifact "loss" does not prevent observation, surface scatter impacts will be highest in exactly those areas where conversion is most desirable--low slope, fine grained soil locations with heavy growth of brush. Unfortunately, these same situations commonly contain archeological sites, at least in this area.

Control Locus Pot Burials

Overviews - As outlined above, four burials testing three variables were placed in noncultural locations at the control locus (Fig. 21). The three variables were, again, soil textures, depth, and cover. Testing was done by simple dichotomized comparison: fine/rocky texture; shallow/deep burial; present/absent brush cover. Results of the tests are presented in Table 8.

Pot Burials - These observations are based on a combination of field and photographic interpretation. The photographs serve primarily to illustrate the field interpretations.

Burial #1 - This control was placed in a fine-textured humus and sandy loam soil with no vegetative cover. The lower set of pots was placed about 35 centimeters deep while the upper set was about 20 centimeters deep with about 5 centimeters of soil over the top. All pots were set vertically as if on a buried floor and the soil was packed back into the pit to approximately its former consistency. Recovery of the pots after 2 months with periodic rainfall showed no additional compaction or settling of the fill and pit walls were difficult to redefine. This held true in all cases, control and test, indicating that an approximate replication of natural conditions had been achieved (Fig. 61).

Both sets of pots were recovered without damage (Fig. 62).

Burial #2 - This burial was placed in a fine-textured soil consisting of clay and humus mixed with sandy clay loam, under the dripline of a manzanita (Fig. 63). The lower set of pots was at about 37 centimeters, leaving about 5 centimeters on top. All were placed vertically.

On recovery, the large upper pot was found to be broken by expansion of the clays in the soil. This is clearly seen in Fig. 64, where clay can be seen to have extruded into the cracks it had produced. No other damage to the pots was noted. It is felt that the periodic rain and overnight frosts which occurred between layout and recovery were responsible for the destructive action of the expansive clays. Unfortunately, the expansive nature of the clay was not recognized at the time of the layout.

Fig. 61. Oblique View, Control Burial #1
(Layout)

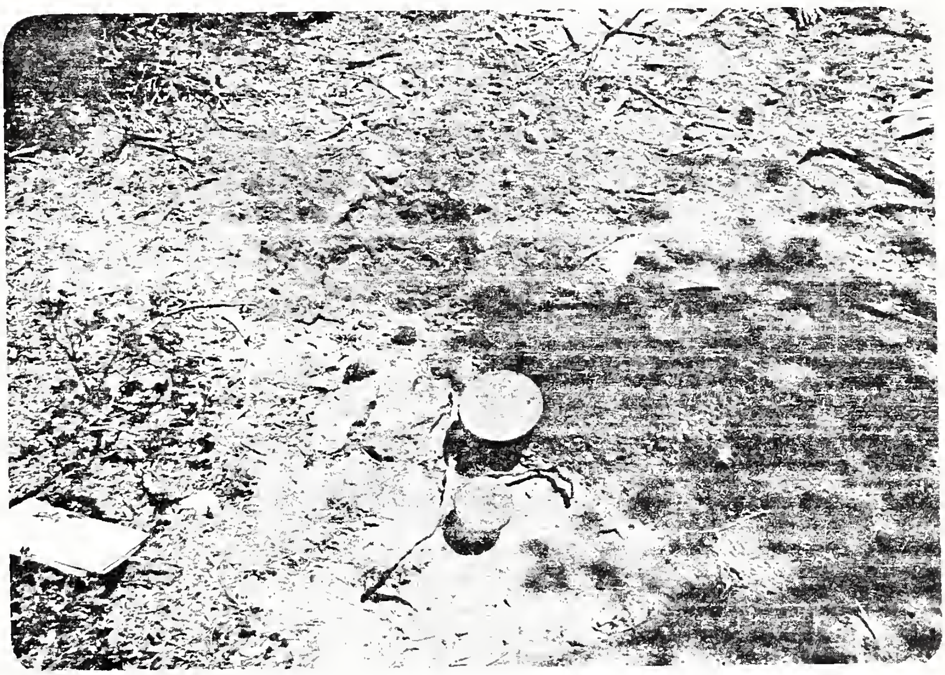


Fig. 62. Oblique View, Control Burial #1
(Recovery)

Fig. 63. Oblique View, Control Burial #2
(Layout)

Fig. 64. Control Burial #2
(Recovery) Showing Pot Broken By Clay Expansion

Table 8. Pot Burial Impacts - Control Locus

Breakage By Level	Burial 1	2	3	4
Upper (2 pots)				
No.	0	1	1	1
%	0	50	50	50
Lower (2 pots)				
No.	0	0	2	0
%	0	0	100	0
Total (4 pots)				
No.	0	2	3	1
%	0	25	75	25
Overall				
Upper (8 pots)				
No.	3			
%	37.5			
Lower (8 pots)				
No.	2			
%	25			
Total (16 pots)				
No.	6			
%	37.5%			

Burial #3 - Dug into a rocky clay-sand soil, this burial again had no brush cover (Fig. 66). The lower set of pots was at 33 centimeters, the upper at 18 centimeters, and the top cover was 3 centimeters. Rocks in the burial pit ranged in size from gravel to about 10 centimeters diameter.

The larger pot in the upper set was broken when recovered, again by expansive clays. The smaller of that set was intact (Fig. 67). Both pots in the lower set were broken into small pieces by the force of clay against rock (Fig. 68).

Burial #4 - The last control burial was placed in rocky clay and silt clay loam soil. Brush cover was provided by locating it within a small patch of manzanita, oak, and juniper (Fig. 69). Rocks in the pit ranged in size from gravel to 5 centimeters diameter. The lower pots were set at about 37 centimeters of top dirt.

Recovery of the upper large pot showed that it had also burst by expansion. All other pots were intact (Fig. 70). The only damage in this or any burial was breakage. As expected, no displacement of the material was seen in this or any other control burial.

Experimental Burial Locus

Overview - The determination of depth for the test burials followed the same criteria of local archeological representation as at the control locus. The same variables tested with the controls were tested here and layout of the burials was similar. During the test, all four pits were crushed on a single pass through the locus. Three were contacted on a straight line while the fourth was crossed in a shallow right turn. This turn caused the Marden to slew and jump somewhat as it pulled against the offset (see above). The layout of the locus is shown in Fig. 22 while Fig. 90 and Table 9 describe and summarize the results.

Pot Burials - These observations, again, are a combination of field and photographic interpretation, utilizing the photographs primarily for illustration.

Burial #1 - This test was dug into a fine-textured sandy clay loam soil, low in humus and containing no expansive clays. No vegetative cover was present (Fig. 71). Depths of burial were 33 and 18 centimeters with a 3 centimeter cover. All pots were positioned vertically. Compaction was comparable to that of the natural surface, as described above.

Fig. 65. Oblique View, Control Burial #2
(Recovery) Showing Total Damage

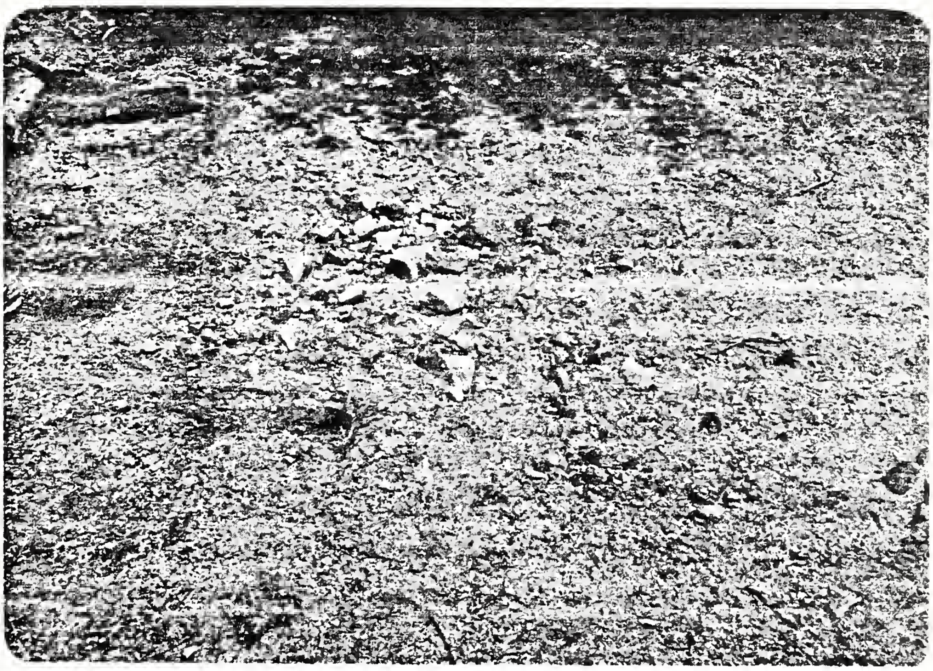


Fig. 66. Oblique View, Control Burial #3
(Layout)

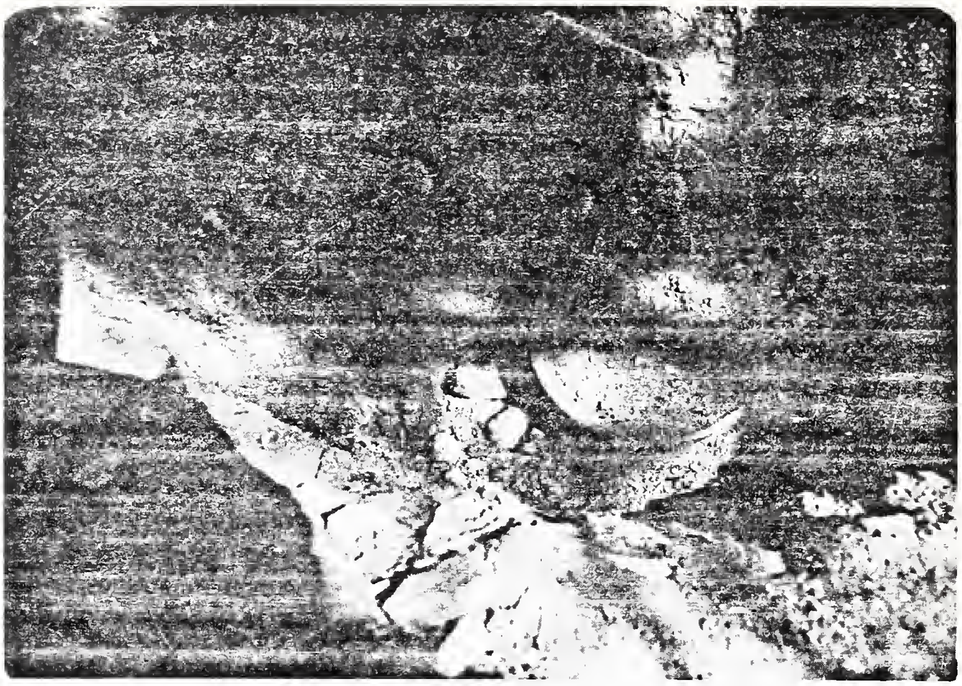


Fig. 67. Control Burial #3 (Recovery)
Showing Upper Set of Pots

Fig. 68. Control Burial #3 (Recovery)
Showing Total Damage

Fig. 69. Oblique View, Control Burial #4
(Layout)

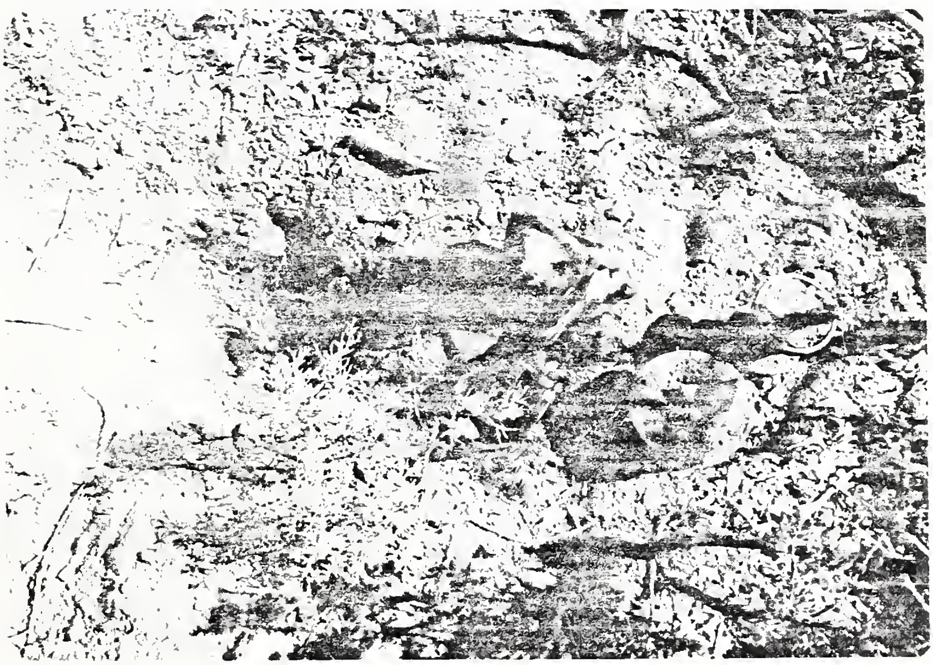


Fig. 70. Control Burial #4
(Recovery)

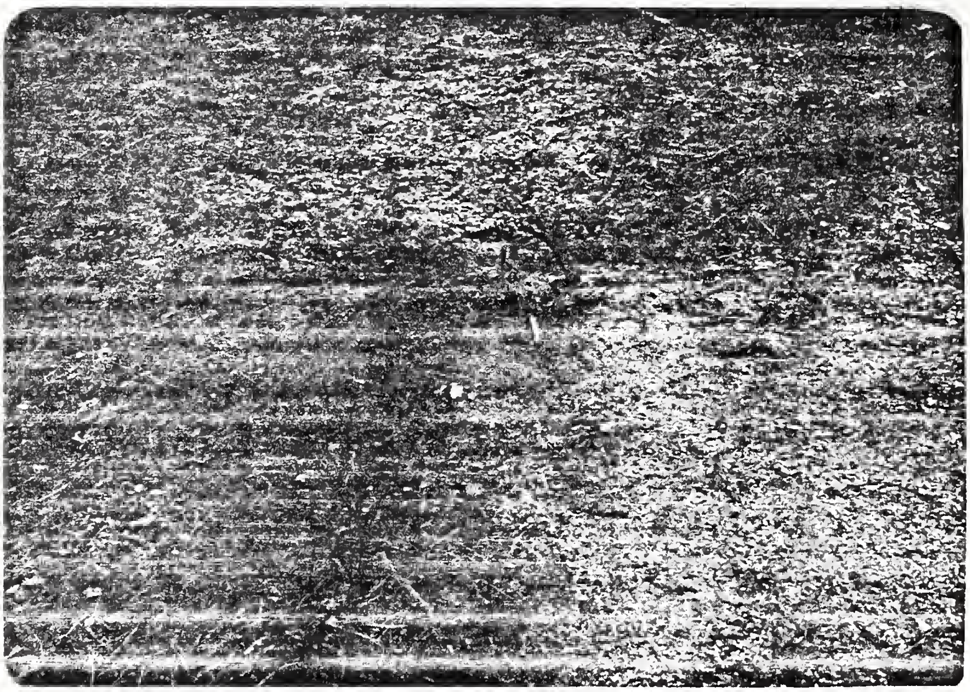


Fig. 71. Oblique View, Test Burial #1
(Layout)

Fig. 72. Oblique View, Test Burial #1
(Recovery) Showing Blade Furrows

The blade furrow pattern over the burial after crushing left strips of relatively undisturbed surface (Fig. 72). These strips had, however, been raised and softened by the pivoting of the blades (Fig. 50).

It was found on recovery that none of the pots had suffered any direct damage, as the blades had passed over them, leaving furrows on either side of the pit (Fig. 90a and b). The only damage incurred was some slight gouging of the surface of the large upper pot by rocks which had been displaced by the blades (Figs. 73 and 74). Total damage caused by crushing was, therefore, no greater than that received from natural causes at control burial #1 (Tables 8 and 9).

Burial #2 - In fine-textured soil high in humus and with no expansive clay, this burial was set 29 centimeters beneath the dripline of a manzanita to provide a brush cover (Fig. 75).

During the crushing operation, a small juniper was dragged into the burial pit over the top of the crushed manzanita. The ground surface under all this was mixed and churned rather than distinctly furrowed (Fig. 76), another indication of the effects of broken brush on the process.

Recovery of the pots showed that a blade had contacted the upper large pot even through the thick brush cover (Fig. 90c and d). This shattered the pot and crushed a portion of the rim to powder (Fig. 77). The impact was vertical with no apparent displacement of the pot or its fragments. However, many of the breaks showed grinding facets, indicating that some erosion had been applied to the pot during contact. Also, powder from the pot was ground into small areas in the surrounding fill. The small upper pot was intact and showed no damage at all, nor did either pot in the lower set. Total damage to this burial, while greater than to Burial #1 (Table 9), was no more than incurred, naturally, at control Burial #2 (Table 8). Impact from the Marden device was, in this case, no more destructive than burial in expansive clay.

Burial #3 - The pit for this test was located in a rocky-textured soil, low in humus and containing no expansive clay. It was 31 centimeters deep and had no vegetative cover (Fig. 79).

The path taken by the crusher over the test was straight and left distinct furrows with more or less intact strips between them, though mixing in the furrows raised, softened, and fractured the strip surfaces somewhat (Figs. 80 and 81).

Fig. 73. Test Burial #1 (Recovery)
Showing Upper Set of Pots

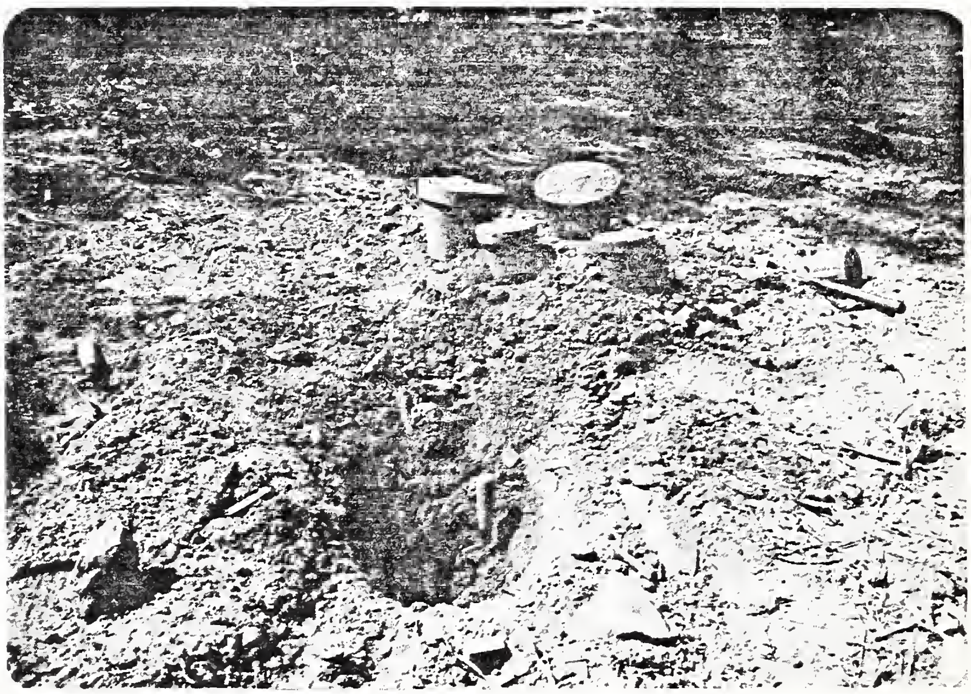


Fig. 74. Test Burial #1 (Recovery)
Showing Total Damage

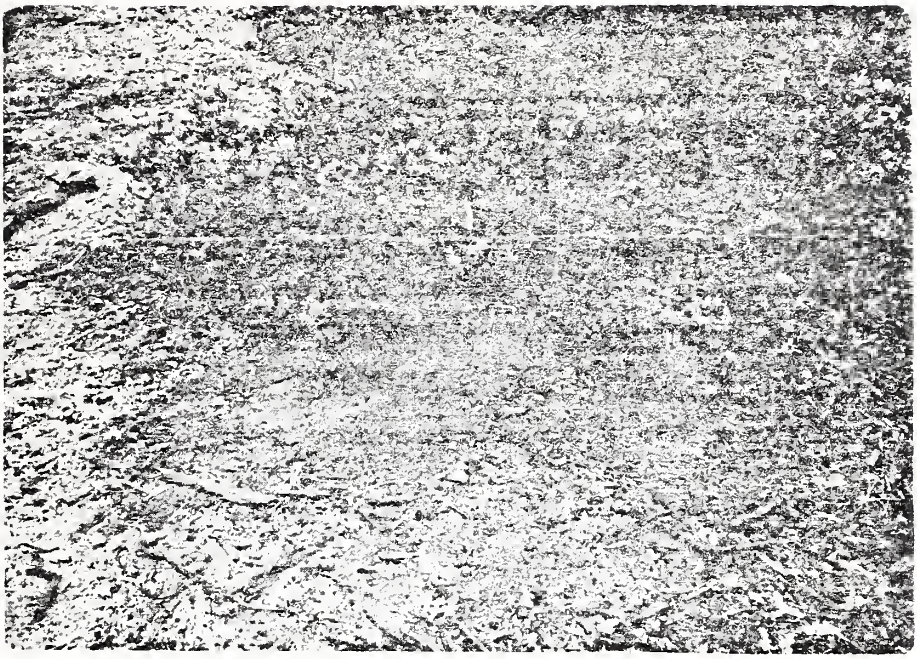


Fig. 75. Oblique View, Test Burial #2
(Layout)

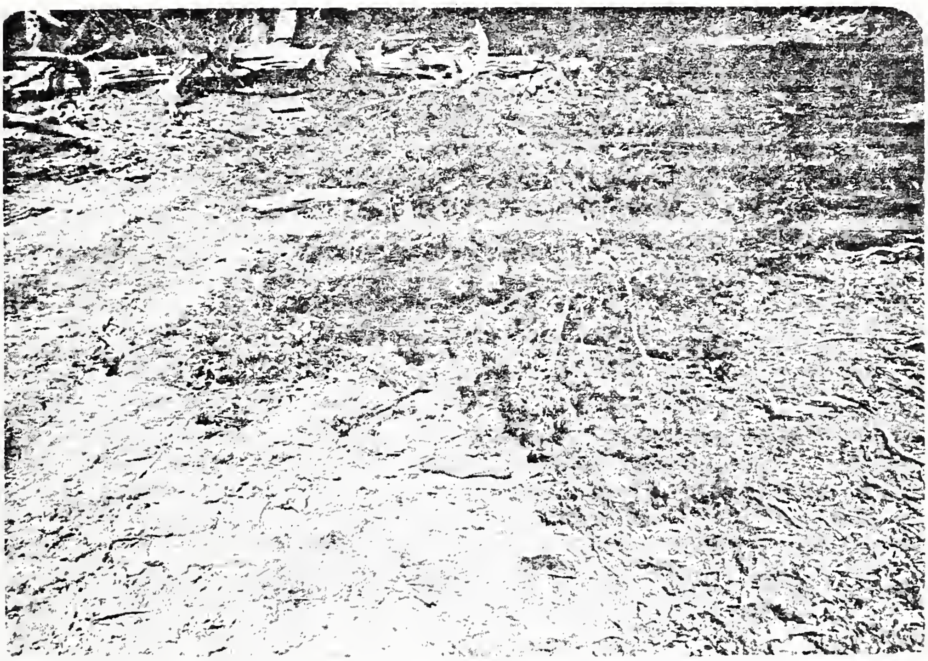


Fig. 76. Oblique View, Test Burial #2
(Recovery) Showing Marden Effect on Vegetation

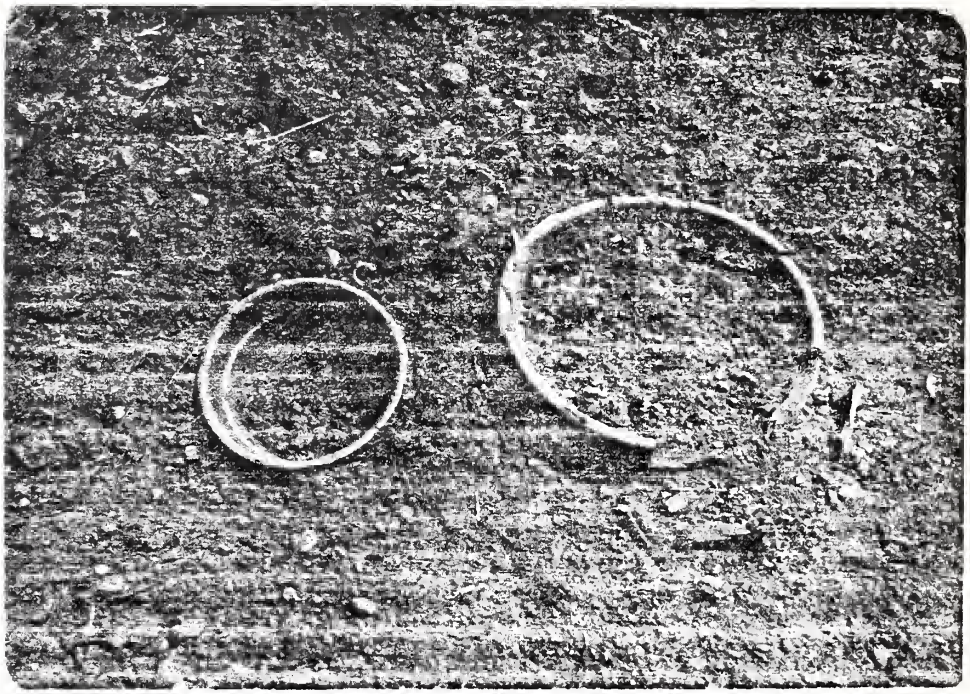


Fig. 77. Test Burial #2 (Recovery)
Showing Upper Set of Pots

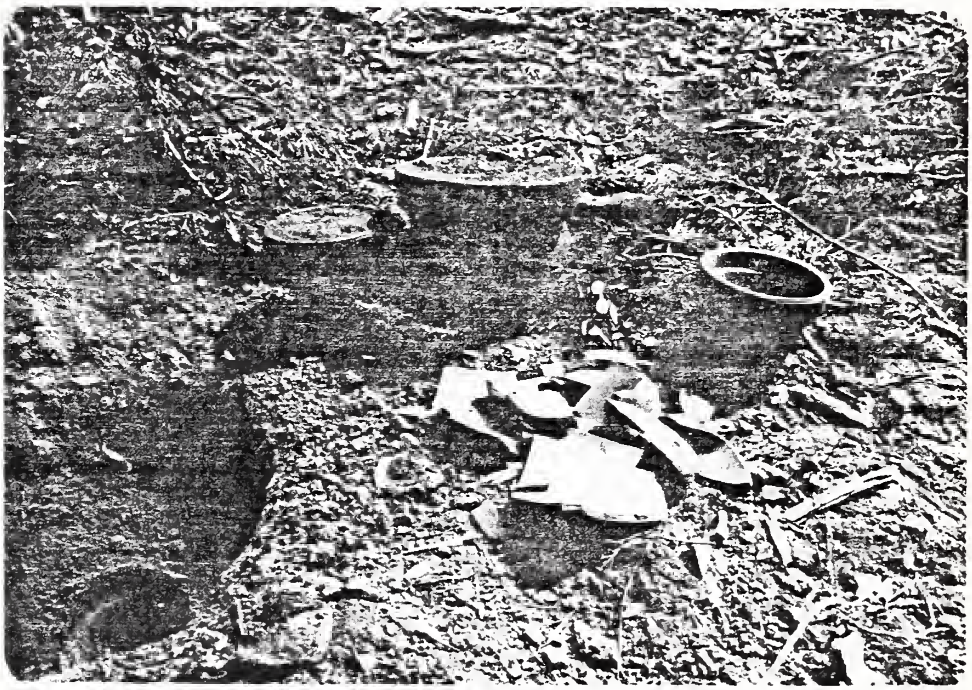


Fig. 78. Test Burial #2 (Recovery)
Showing Total Damage

Fig. 79. Oblique View Test Burial #3
(Layout)

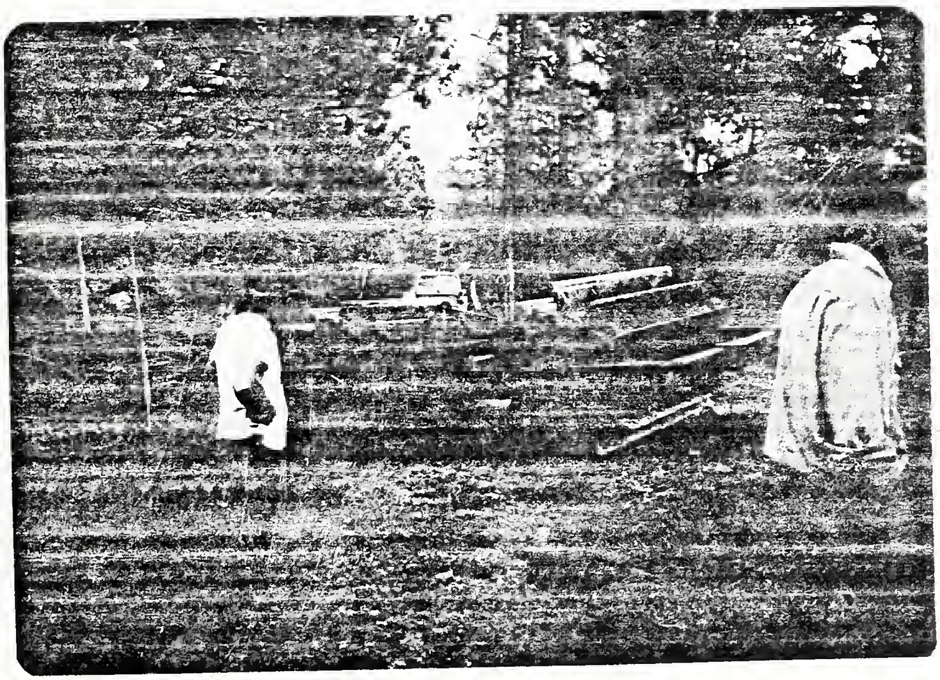


Fig. 80. Test Burial #3 Being Crushed

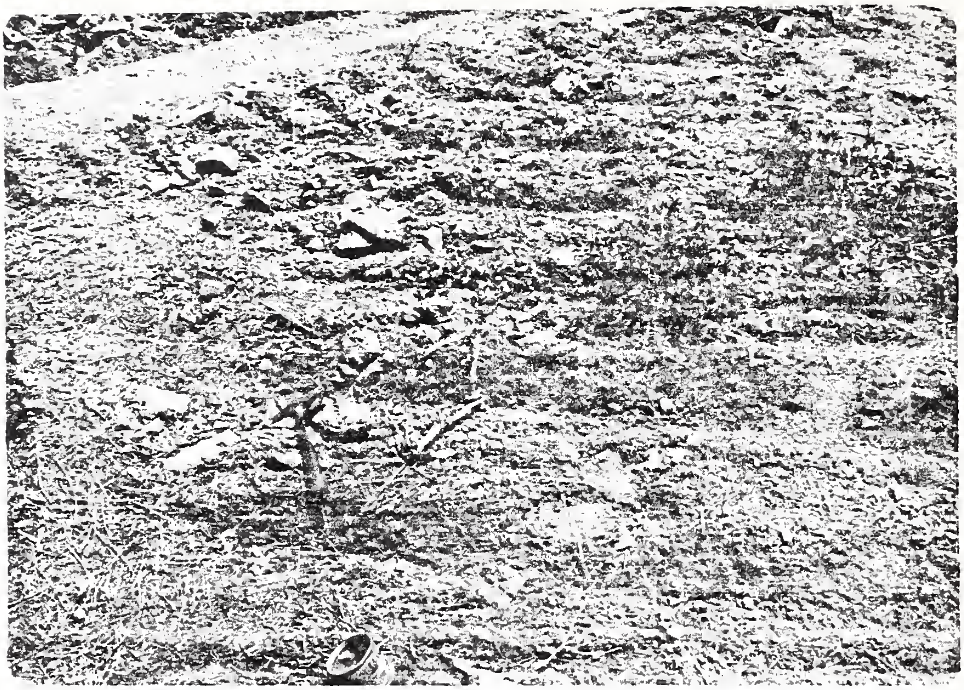


Fig. 81. Oblique View Test Burial #3
(Recovery) Showing Blade Furrows

Fig. 82. Test Burial #3 (Recovery)
Showing Upper Set of Pots

Table 9. Pot Burial Impacts - Test Locus

Breakage By Level	Burial 1	2	3	4
Upper (2 pots)				
No.	1	1	2	2
%	50	50	100	100
Lower (2 pots)				
No.	0	0	1	1
%	0	0	50	50
Total (4 pots)				
No.	1	1	3	3
%	25	25	75	75
Overall				
Upper (8 pots)	6:75%			
Lower (8 pots)	2:25%			
Large (8 pots)	5:63%			
Small (8 pots)	1:13%			
Total (16 pots)				
No.	8			
%	50%			

No blade contact was made with either set of pots but close blade proximity (Fig. 90e and f) produced breakage of rims in the upper set by the movement of subsurface rocks (Fig. 82). This churning displacement produced some grinding and powdering of sherd edges in the breaks, as at Burial #1. The small pot in the lower set was left intact, but the larger pot also suffered some rock impact breakage of the rim (Fig. 83). Total damage here was the same as at the control burial of this type, though the location of impacts was different. Highest at depth in the control situation, they were highest here near the surface. Again there appears to have been a different mechanism of damage. No clay was present in the test burial and all indications are that the test damage was derived from the crushing. A strongly indicated factor in assessing impact appears to be the percentage of rocks in the soil--a higher percentage would seem to lead to a higher incidence of damage to subsurface materials, regardless of the cause of the impact.

Burial #4 - The last test burial was located in a relatively rocky-textured soil which also contained a high percentage of humus, but no clay. Twenty-eight centimeters deep, it was placed under the dripline of a large manzanita (Fig. 84). The upper large pot was buried on its side while the others were buried in the standard upright position.

The Marden crossed the test on a shallow right-hand turn, opposite the roller offset, resulting in extreme surface disruption and mixing with broken brush (Figs. 85, 86, and 87). This action produced multiple furrowing, the last set of which was quite deep and distinct. The first set was obliterated and reformed by the second.

The upper set of pots suffered considerable damage (Fig. 88). The horizontal pot was impacted by the first roller and shattered. The blades from the second scattered sherds from this pot through the churned-up soil, lifting some of them all the way to the surface. The small pot was shattered in place. In the lower set, the small pot was unharmed, but the large one was impacted by a displaced rock, which crushed and broke part of the rim. Fracture lines from this impact ran through the sides of the pot nearly to its base.

Compared to the results from the burial in the same conditions at the control locus, three times as much damage, by percentage, was inflicted on the test. Again, there was difference in the mechanism and different patterns of damage between the test and control.

Fig. 83. Test Burial #3 (Recovery)
Showing Total Damage

Fig. 84. Oblique View, Test Burial #4
(Layout)

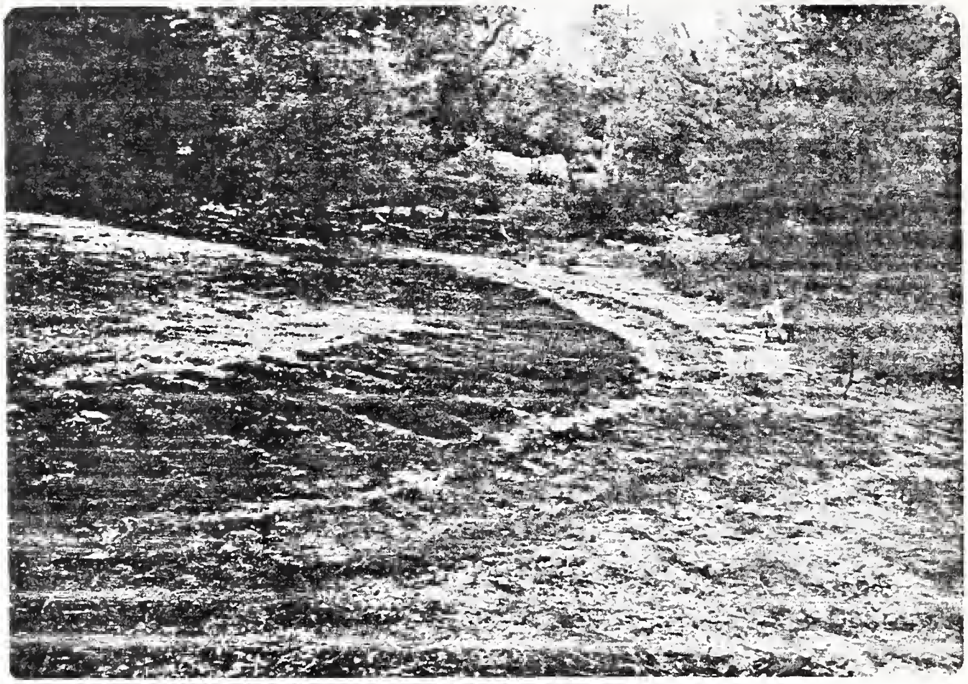


Fig. 85. Path of Crusher to Test Burial #4
Across Bare Soil

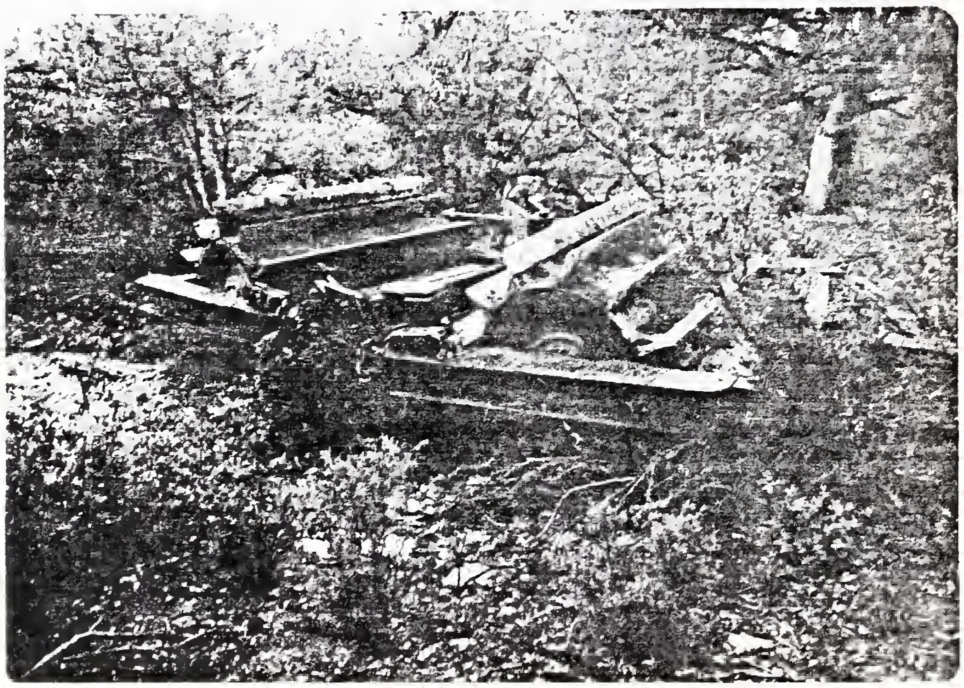


Fig. 86. Test Burial #4 Being Crushed

Fig. 87. Oblique View, Test Burial #4 (Recovery) Showing Blade Furrows and Exposed Sherd (Circled)

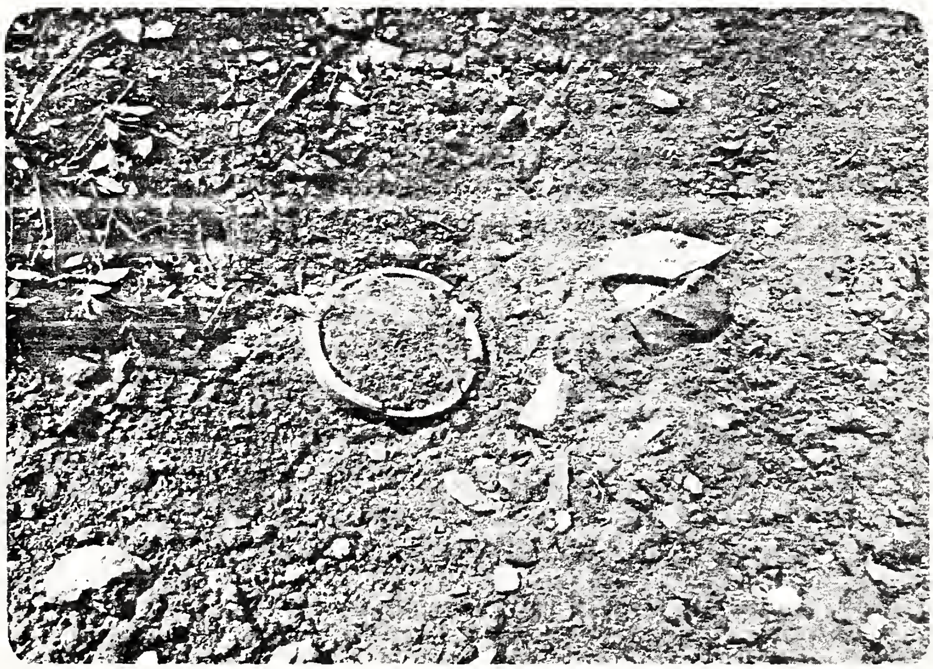


Fig. 88. Test Burial #4 (Recovery) Showing Upper Set of Pots

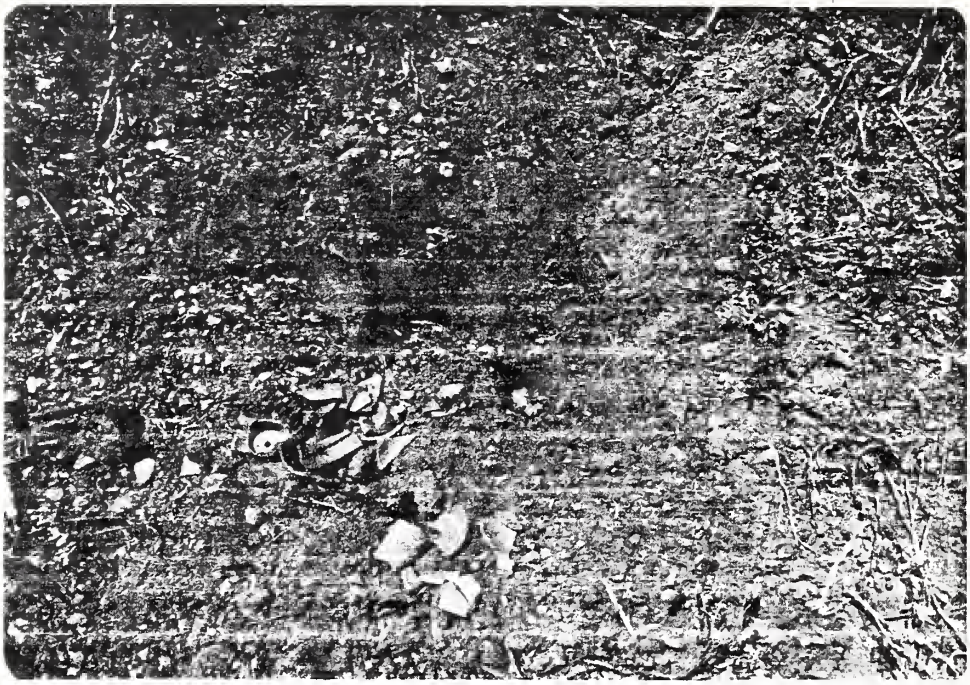


Fig. 89. Test Burial #4 (Recovery)
Showing Total Damage

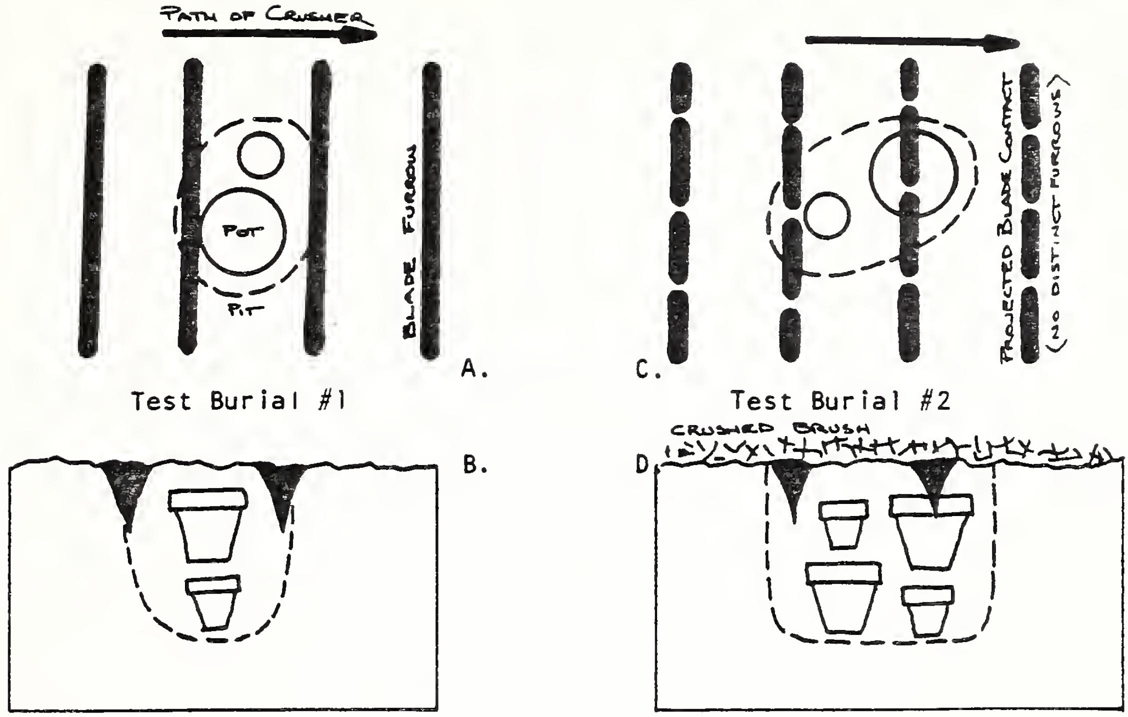
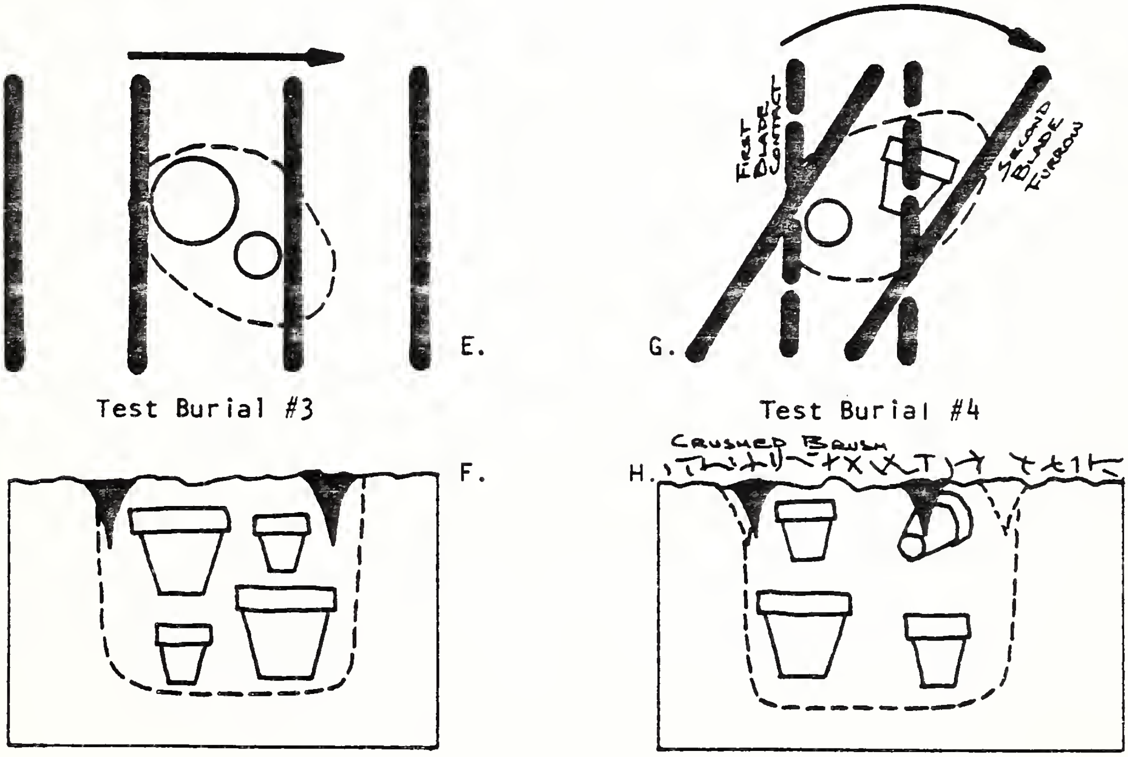


Fig. 90. Patterns of Blade Impact on the Four Test Burials



Results and Comparisons

Fifty-two surface artifacts were originally identified in the four test squares, 86.54 percent of which were impacted in some way. By far the most common impact was loss from the observable surface inventory. Out of 63 instances of one or combinations of the four types of impacts, 61.9 percent of the impact was loss. Next in importance were displacements and additions of new material, with breakage being the least frequent. This represents a much different pattern of impacts from the control site where the most frequent disturbance was breakage. Thus, the information presented in Tables 9, 10, and 11 indicate that use of a Marden device produced four times as much impact to surface artifact scatter and structural components than did natural causes at the control site. While this ratio may have no meaning outside the specific context of this test (and conceivably as little inside), the tables record distinct differences in the nature of these impacts. Natural causes produced primarily breakage of artifacts in place-simple deterioration, with minor relocation of runoff. No structural changes were observed in 2 months time, indicating that natural lateration of features is a slow process involving widely separated small increments of change. Marden impact produced a pattern of change characterized by the sudden loss of a large amount of the surface artifact inventory with little replacement from the subsurface population. This, combined with breakage and displacement, means a sudden change in 90 percent of the surface artifact inventory of a site. In the case of a very shallow site with little or no depositon, this would constitute near-total disruption of the property. Even in the case of deeper sites, the recognition of its character would be seriously impaired if suddenly over half the visible artifacts were to disappear. In addition to the impacts of artifacts, the Marden device served to displace and bury structural materials, something that could also have bearing on the recognition and characterization of cultural properties. And whatever its direct effects are on a site, the Marden device invariably opens and softens soil surfaces, making them susceptible to erosion and to subsequent further artifact displacement by mixing from grazing, vehicular travel, and even walking. The deep footprints visible in some photographs presented here is evidence of that--they appear in the recovery photos, but not in those taken prior to crushing.

Soil Loss Considerations

The observation made above would appear to be an especially pertinent one, as soil loss immediately following conversion treatments is common and can sometimes be quite high (Boster and Davis, n.d.). However, different treatments tend to have different impacts in terms of surface erosion,

Table 10. Summary of Surface Impacts - Control

Artifacts

Impact	No.	%-age
Displacement	1	20
Breakage	2	40
Loss	1	20
Addition	1	20
Original No. Artifacts	28	
Total Number Impacted	5	
Overall impact to original inventory		17.85%

Structure

Impact	No.	%-age
Displacement	0	0
Breakage	0	0
Loss	0	0
Addition	0	0
Original No. Structural Components	15	
Total Number Impacted	0	
Overall Impact to Original Inventory		0%

Table II. Summary of Surface Impacts - Test

Artifacts

Impact	No.	%-age
Displacement	10	15.87
Breakage	5	7.94
Loss	39	61.9
Addition	9	14.28
Original No. Artifacts	52	
Total Number Impacted	45	
Overall Impact to Original Inventory		86.54%

Structure

Impact	No.	%-age
Displacement	7	53.85
Breakage	0	0
Loss	4	33.77
Addition	2	15.38
Original No. Structural Components	23	
Total Number Impacted	11	
Overall Impact to Original Inventory		47.83%

and the type of mechanical treatment used in this case may be one of the less damaging. Owing to the relatively low slope necessary to use the Marden and to its lack of provision for removing foliage or vegetation, as with fire or herbicide/defoliant sprays, two of the major factors in increasing soil loss after treatment are eliminated with this method. Rainfall impact movement and runoff removal of loosened and exposed sediments will increase following conversion, particularly during high-intensity summer storms. At the very least some loss of fine sediments and organics from the surface can be expected, leaving gravel pavement surfaces such as were observed in several exposed places in the study area (Figs. 13, 14, 65 and 84). This action may result in gullying in those locations where the surface sediments are more susceptible to it (Boster and Davis, n.d.). One factor which may serve to minimize this form of soil loss is that broken vegetation is left on the ground after crushing, so that some areas at least will retain rainfall impact protection. Herbicides and burning, while probably doing less direct damage to site surfaces, do not provide this type of erosion protection. In areas where surface litter was the primary soil cover, crushing will open and remove this protective layer.

In the long run, conversion treatments tend to reduce and can even reverse soil erosion (USDA, 1975; Boster and Davis, n.d.), but considering that conversion to grass may take several years, there is an inevitable risk of soil loss after treatment. If no measures are taken to prevent this loss, erosion originating on treated soil surfaces near cultural properties might result in the same resource loss that avoiding the property was intended to prevent.

It is suggested here that minimal initial soil loss following Marden treatment can best be achieved by staggering treatment areas in relatively small, noncontiguous parcels (vegetative mosaic), proper treatment site selection to minimize erosional potential from slope and substrate, and a "strong post-treatment maintenance commitment" (Boster and Davis, n.d.). The sooner that grass cover is established after treatment, the better--both for the success of the conversion and for the integrity of cultural resources.

Factors in Assessing Impacts

Damage from the Marden device as observed here was dependent on four factors: 1) contact with the blades; 2) soil texture; 3) depth; and 4) artifact size. Contact with a blade invariably produced both surface and subsurface artifact damage or displacement. Rocky soils or soils with expansive clays produced a high percentage of subsurface damage, while fine soils produced the most damage (by displacement) in surface inventories. However, it must be noted that the presence of residual

clays and large numbers of rocks in a surface soil is usually a result of natural, inplace development rather than cultural deposition, though this is not always the case. While it was expected that certain amounts of cover would act to provide a protective cushion over cultural surfaces and fill, while others would not, the results of the test indicate little or no difference due to cover. It can be said, then, that cover has no effect and is, therefore, not a factor in the amount of impact. The third factor, depth, proved highly useful, as damage was higher in shallow burials than in deep, and highest on the surface itself--25 percent of deep burials were impacted, 75 percent of shallow burials, and 86 percent of the surface inventory. Clearly, impact increases as depth decreases. Finally, there was the factor of artifact size. The ratio of large to small buried pots broken at the control locus was 3 to 1; at the test burial locus, it was 5 to 1. As well, only the larger surface artifacts were ever physically damaged (e.g., the metate at 19220), and the effect of sherd breakage was to reduce average sherd size. This too indicates a strong pattern--larger artifacts have a higher susceptibility to damage. In some cases, this was apparently due to larger area of potential blade or rock contact, while in others it may have been due to the larger artifact's having had less structural integrity than a smaller one of the same materials. Unfortunately, these observations must remain tentative and inconclusive, as much more variability was encountered than expected in the variables of soil, surface, and brush composition. Still, it can reasonably be said that under the variety of conditions tested, nearly 90 percent of the cultural surface and 50 percent of the subsurface inventories were damaged by crushing.

Discussion

Impacts, Effects, and Information Losses

It is a matter of both scientific interest and Federal law that the goal of cultural resource management in the Forest Service is to protect and preserve the information contained in cultural properties. The question at this point is whether or not the effects on this goal can be identified for this management practice.

The direct impacts of brush crushing to cultural properties identified from this study were as follows: 1) disruption of the spatial relationships of surface and subsurface artifacts; 2) disruption of structural elements in surface and subsurface architectural features; and 3) physical damage to surface and subsurface artifactual materials. Indirect impacts to these properties may arise from erosion and, in some cases, from increased site visibility, which tends to invite vandalism.

The type of information that suffers most from the direct impacts of crushing is critical to the understanding of past behavior--that of the location and spatial relationhships of the remains of those behaviors. To disrupt or destroy the spatial context of these remains severely limits any attempt to characterize and identify not only specific behaviors at sites but sites themselves and the regional and chronological patterning of occupations and developments. On the other hand, no archeologist has ever worked with a pristine site. No matter how well protected and preserved, all sites and the spatial patterns they contain have been modified to a greater or lesser extent by time and natural agents of erosion and decay. The question now becomes one of identifying an acceptable level of disturbance that is compatible with continuing land use and yet still allows the preservation of information. Unfortunately, this is a question that is still unanswered in archeology. Each year sees more information recovered from less material as archeologists utilize and develop new methods to expand the definition of archeological data. And yet, there is no definition of what constitutes an acceptable, workable level of disturbance. Nor will there ever be, in all probability, because the answer always depends on the problem. What may be totally unnecessary to one scheme of interpretation becomes the focus of another. Ultimately, the problem of acceptable disturbance is not quantifiable but is relative in all cases, and so must become a legal problem if it is to be dealt with in a workable way by land managers.

At present, the only legal guideline relating to this problem that is available to Federal agencies is 36 C.F.R. Part 800, specifically 36 C.F.R. 800.8 and 800.9, the criteria for adverse effect. According to these guidelines, the "destruction or alteration of all or part of a property" constitutes an adverse and, therefore, legally unacceptable effect to that property. Since the spatial relationships of artifactual materials and the actual materials themselves consitute a major part of any definition of an archeological site, the disruption to these materials and relationships described above must be seen as having an adverse effect. This being the case, it must be recognized that the use of a Marden brush-crusher in areas containing cultural properties cannot be allowed without some measure of protection being given to those properties.

Potential Protective Measures

One method to minimize the impacts described above might be to allow crushing but only on those sites where intact artifactual spatial relationships are least critical to the understanding of the nature of the site. An example might be an area of thinly scattered surficial

material, without depth, secondarily deposited by slopewash on an active erosional surface. Crushing could also be confined to those areas with specific soil structures and compositions demonstrated by further, more sophisticated testing as minimizing disturbance. Specification might be made that no turns take place in undisturbed or cultural areas and that passes not overlap. However, such restrictions might limit the effectiveness of the conversion and would still result in damage to cultural properties. This being the case, other types of conversion might be employed, such as herbicides or controlled burning--though little is known of the effects or after effects of these practices on archeological sites in the chaparral. My own casual observation of the effects of herbicide control on mesquite brush in southern Arizona indicates that it is far less harmful, at least where a healthy grass cover was established by the next storm season. If nonmechanical conversion could be determined suitable for use on archeological sites by experimental testing, a mixed approach to conversion might be taken that would utilize herbicides or burning on or near cultural surfaces and mechanical treatment on others.

Finally, there is the more-or-less standard approach of avoidance. As discussed above, this would mean leaving islands or corridors of standing unconverted vegetation in the treatment area. In some cases, this will lessen problems with erosion and site visibility. In others, it will create them by providing no erosion protection and by drawing attention to the properties as their presence would quickly be associated with standing islands of brush. However, this method is also good for wildlife management and, if properly done, the patterning of corridors which would be optimal for wildlife should be compatible with the irregular archeological site patterning and placement most commonly found in the chaparral. It is also usually compatible with the topographic operational limits of crusher operation. The combination of these three factors would allow the creation of islands and corridors which could include both cultural and noncultural areas and still provide enough area to make conversion profitable, at least in most cases. Laying out a "natural/cultural mosaic" such as this would take time and interdisciplinary cooperation to do properly, but until another method can be approved by testing, the demonstrated ability of avoidance to protect the cultural resource from management impacts and its compatibility with other management goals far outweigh its costs in time.

Recommendations

Chaparral conversion utilizing a Marden brush-crusher is disruptive and damaging to both surface and subsurface cultural materials and features, at least as it was observed here. It should, therefore, be regarded as having an adverse effect on cultural properties as that effect is defined in 36 C.F.R. 800.9. The findings of this study indicate that the best, cheapest, and most effective measure for cultural property protection from these impacts remains that of avoidance, at least until more variables and more conversion methods can be tested. Avoidance has been recognized as appropriate and effective in chaparral conversion projects since at least as early as 1975 (USDA). The other methods outlined above may eventually prove feasible, but must be tested prior to any adoption in policy.

Conclusions

The primary purpose of this study has been to design and implement a program of experimentation which can provide useful information for the management of cultural resources held by the U. S. Forest Service and to inform land managers of the potential impacts to cultural properties resulting from the disturbance activities of surface mechanical treatments for chaparral conversion. It was recognized from the outset that this program ran a high risk of irretrievable damage to and/or loss of significant and valuable resources. However, the information gained from the experiment, combined with the site descriptive information which was recorded, was felt by the Region, the Forest, and the Arizona State Historic Preservation Officer to be at least as valuable as any which would reasonably be lost during the experiment.

Intelligent and informed land management and the future protection and preservation of cultural resources on National Forest lands must take place in the context of the multiple use management directives, goals, and policies of the Forest Service. This requires that objective and empirically--based assessments of the potential impacts to these resources by surface--disturbing management activities be made available for use in such management. This study was designed to provide that information for one activity in one locality. The risk of losing a part of the resource in order to obtain this information is seen as necessary to ensure the authenticity of the assessment. It is hoped that the end result of this study will be to protect and preserve other sites from this type of damage and destruction.

This study and the tests developed for it must, in this same context, be considered only as a first approximation of what eventually needs to be done for all potential impacts to Federally held and managed cultural resources. It has served to identify and give a preliminary assessment of the problems and impacts of mechanical treatment for chaparral conversion. Owing to limitations in the variability of the test environments and the artifactual contents of the test loci, it cannot be considered truly representative of all such impacts under all conditions, but it can serve as a guide for future interpretations. If nothing else, it should indicate that there is a need for studies such as this, to identify and assess the problems of other management activities. Once such information is available, it may be possible to formulate and test a general impact management policy for a variety of different land uses and management practices in a number of environments.

Suggestions for Future Research

It is apparent that this study suffered a number of deficiencies, and was unable to make a definitive statement regarding levels of impact or prediction of impact. These problems can be traced directly to the small scale of the program, the small number of sites and limited area available for testing, and the limited time and money set aside for the project. In order for a study of this nature to be truly effective, more is needed in the way of test variables and controls than were utilized here. To begin with, only one nonoverlapping, nonturning pass was made over each test square and burial (one exception). Slope in all cases was less than five percent, though sites were located in other topographic situations, and it was observed in other parts of the study area that the device produced a markedly higher level of disruption on greater slopes. The test loci were not completely crushed as originally intended and no overlapping passes were tested. Only one species of plant cover was utilized, though there are at least three different compositions of chaparral found on archeological sites within the study area. Buried pot orientations had little or no variability and soil composition turned out not to be comparable between the test and control burial loci. In short, a great many potential variables went untested and uncontrolled. The only way in which to attain the levels of information necessary for accurate prediction of impacts is to increase the scale of the test considerably. This will probably require the use of many test and control loci scattered throughout a large, environmentally variable area. It should involve real site tests where possible, combined with artifically constructed site tests for factors not encountered at real sites in the test area. Recovery of data from this expanded test situation should not take place until after the entire area has been crushed. This may result in an inability to relocate some tests, even using a permanent datum

system such as that described here, but difficulty in recognizing sites after crushing is a potential impact. Tests could be designed specifically for this problem. In addition to the site character, composition, and recognition tests, more sophisticated studies of artifact and feature damage should be employed. Considering the complexity and number of factors in defining impacts which surfaced in the present study, a large-scale test such as this is probably the only way in which impact predictions can be developed. However, even when the predictions will only be valid for the environment and cultural properties in which the test was made. General predictions could be based on rigorous comparison of tests from several different areas and archeological assemblages. To do this for even one type of management activity--brush crushing--will cost a great deal and probably take many years, but it is the only way to identify the specific impacts to cultural resources that result from this and other noncultural resource management activities.

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